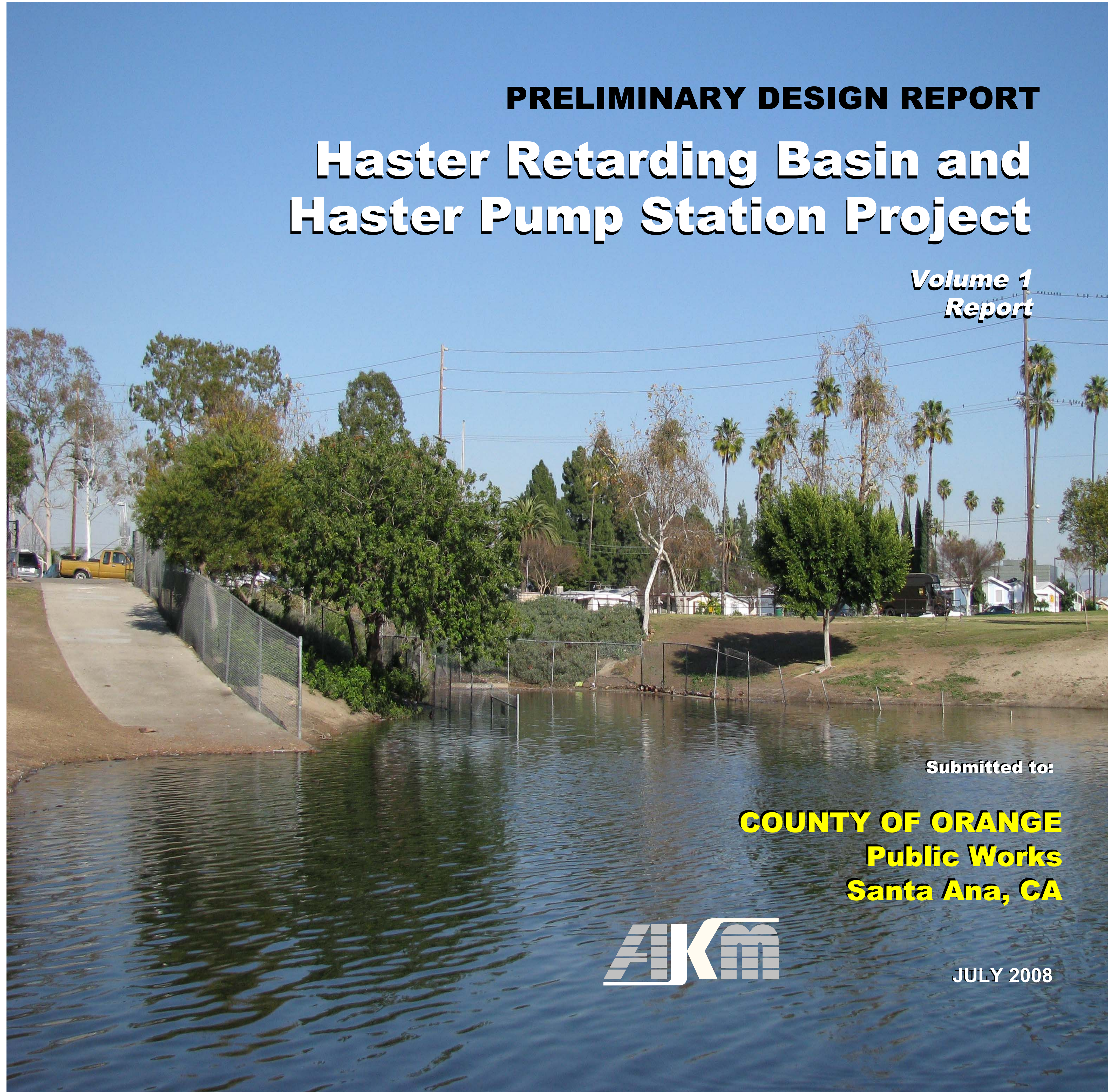
COUNTY OF ORANGE
Public Works
Haster Basin Preliminary Design Report

Volume 1
Report

JULY 2008



PRELIMINARY DESIGN REPORT

Haster Retarding Basin and Haster Pump Station Project

Volume 1
Report

Submitted to:

COUNTY OF ORANGE
Public Works
Santa Ana, CA

JULY 2008

COUNTY OF ORANGE
PUBLIC WORKS

PRELIMINARY DESIGN REPORT
HASTER RETARDING BASIN AND
HASTER PUMP STATION PROJECT

Volume 1
Report

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JULY 2008

TABLE OF CONTENTS

TECHNICAL APPENDICES - Volume 2

Appendix

LIST OF PHOTOGRAPHS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

ES-1 INTRODUCTION

Haster Basin, Orange County Flood Control District Facility C05B01, is located at the intersection of Haster Street and Lampson Avenue in the City of Garden Grove. The purpose of the Basin is to attenuate the peak flows from the upstream 1,845-acre drainage area so that the maximum downstream channel capacity is not exceeded.

Two regional facilities discharge directly into Haster Basin. The East Garden Grove-Wintersburg Channel, Facility C05, is a 9-foot wide by 6-foot high reinforced concrete box (RCB), which has a design capacity of 650-cfs. The Oertley storm drain is a 96-inch reinforced concrete pipe (RCP) with a design capacity of 400-cfs.

The Basin's outlet flows into the downstream extension of the East Garden Grove-Wintersburg Channel, which has an original design capacity of 360-cfs.

The existing drainage facilities were designed in the early 1960s to convey 65% of the 25-year peak discharge. The County's current Hydrology Manual requires that these facilities be designed to convey the peak discharge of the expected value 100-year flood, which is 2,200-cfs.

This report has been prepared to advance the previous studies and provide concept level recommendations for upgrading Haster Basin to attenuate the peak flow from a 100-year, 3-day expected value storm, to the maximum capacity of the downstream channel.

ES-1.1 Previous Studies

The 1994 Project Report prepared by Williamson and Schmid for the East Garden Grove-Wintersburg Channel recommended improvements to the Haster Basin system to provide 100-year expected value flood protection. The report concluded that the existing Basin had inadequate capacity to attenuate the 100-year expected value flow. It determined that the downstream channel design flows should be based upon 450-cfs outflow from the Basin, and recommended a 420-cfs pump station near the outlet of the Basin to provide adequate flood control capacity. The hydraulic data table included on Sheet 15 of the recommended facility plan and profile sheets shows a design discharge of 400 cfs between the Garden Grove Freeway and the Haster Basin outlet.

In 2001, CH_2MHill prepared a Preliminary Design Report to review the recommendations contained in the 1994 Project Report, and to analyze additional alternatives. The Preliminary Design Report concluded that: the maximum downstream channel capacity should be 450-cfs; a 375-cfs pump station should be constructed at Haster Basin; and the island located in the lower lake of the Basin should be removed to provide additional storage volume. The study recommended that the maximum water surface in the Basin be limited to elevation 108.0 feet, to be consistent with hydrology calculations prepared by the City of Anaheim for its upstream storm drain systems, and to eliminate a levied condition at the site.

ES-2 EXISTING FACILITIES

Haster Basin is located on a 22.5-acre parcel of land (21.3-acres of which is owned by the County) that is jointly operated as a City park through an agreement signed between the Orange County Flood control District and City of Garden Grove in 1972. While this agreement has expired, it is still in force until terminated by either party.

The City has constructed a number of improvements at the site that have transformed the flood control facility into a community park (Twin Lakes Freedom Park). The park is maintained by the City and receives moderate to heavy use by the area residents. Facilities located in and around the park include:

- Walking and jogging path around the Basin perimeter
- Children's play area
- Picnic tables, shelters, benches, and trash facilities
- Public restroom
- Exercise stations
- Mature trees throughout the park
- Parking lot for 44 vehicles

An aerial photograph of Haster Basin/Twin Lakes Freedom Park is shown on Figure ES-1.

ES-2.1 Existing Basin Operation

Wet weather and dry weather flows enter Haster Basin through the Oertley and East Garden Grove-Wintersburg Channel storm drains, both with an invert elevation of approximately 96-feet. Influent flow is stored in the Basin up to elevation 103.3 feet, which is the invert elevation of the outlet channel. When the water level rises above elevation 103.3 feet, it flows out of the Basin by gravity into the downstream channel.

Up until the County assumed control of the site from the City, Haster Basin was operated to maintain a normal water surface elevation of 94.5-feet. A small 6-cfs submersible pump located near the outlet was used by the City to control the Basin level. Pumps were automatically started when the Basin level reached elevation 95.0-feet. If the Basin level continued to rise to the elevation of the outlet channel invert, the pump station was stopped and the Basin outflow continued by gravity.

When the lease agreement between the County and the City expired (1997), the County assumed responsibility for Basin operations. The small pump station which was used to control the lake level was no longer operated. It is assumed that this decision was made due to the poor water quality present in the Basin. Currently, the normal water surface elevation of the Basin is about 100-feet. All dry weather flow captured by the Basin is lost either through evaporation or infiltration.

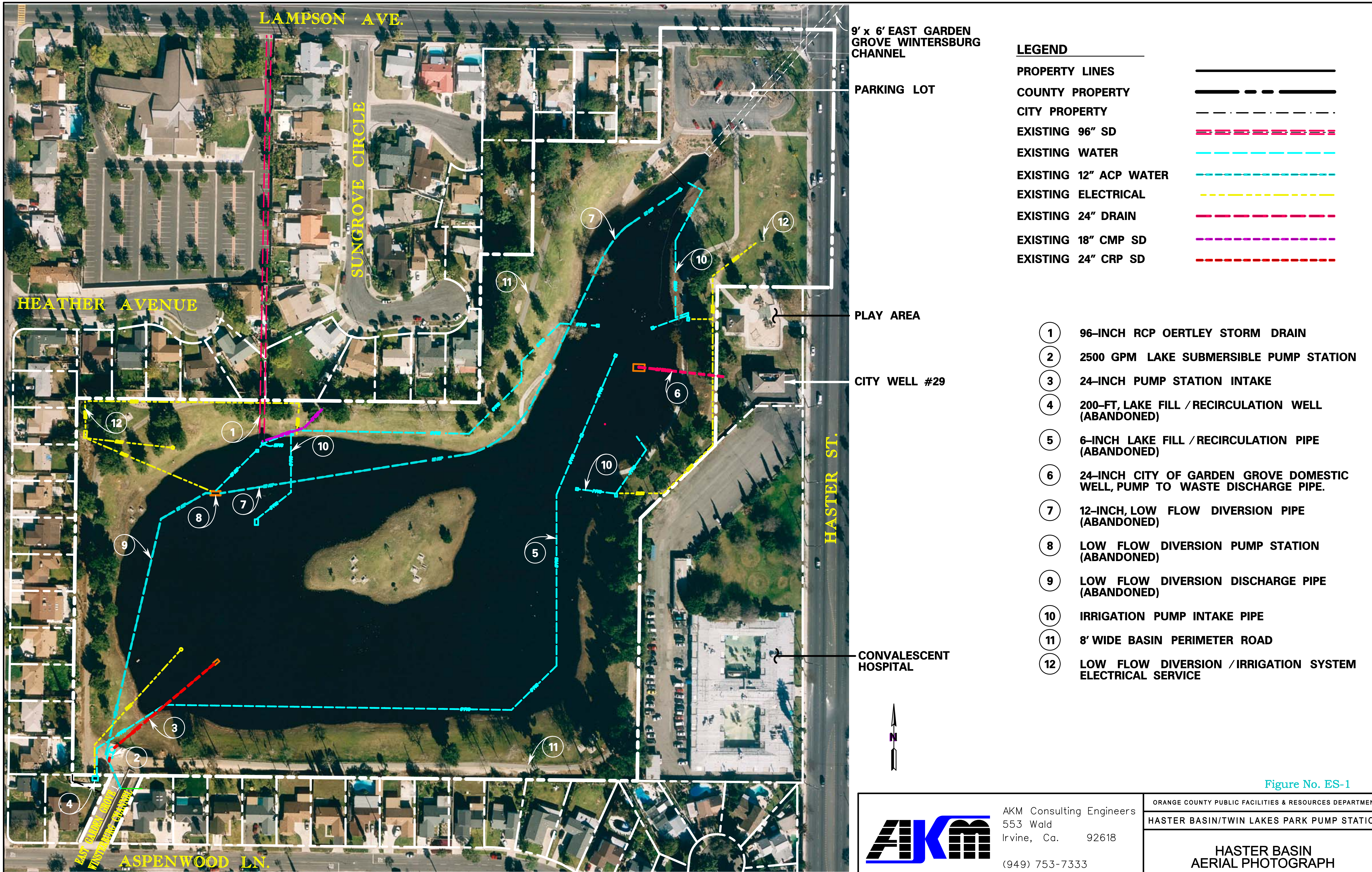

Figure No. ES-1

ES-3 DOWNSTREAM CHANNEL CAPACITY

The hydrologic study for the Haster Retarding Basin, completed by the Orange County Public Works (OCPW), was verified by AKM Consulting Engineers. Both studies developed 3-day expected value 100-year hydrographs for use in subsequent Basin routing studies and pump selections. The primary control for the project is the capacity of the downstream channel, which cannot be exceeded by the pump station peak discharge. The peak flow of the 3-day inflow hydrograph was determined to be 2,193-cfs, and the total runoff volume was 554 acre-feet.

Because the downstream channel capacity impacts the storage volume needed at Haster Basin to attenuate the peak flow of the 100-year expected value storm, hydraulic analyses of the existing C05 Channel was conducted using Basin outflows ranging from 360-cfs to 450-cfs. The results of this study showed that the downstream channel capacity is controlled by the 10-foot wide by 4-foot high RCB at Aspenwood Lane. The available freeboard in the Aspenwood box at the various flows analyzed is presented in the table below.

Q (cfs)	Freeboard (inches)
360	7
400	4
410	3
430	1.5
450	.3

To provide additional freeboard, the slope of the channel from the Haster Basin outlet to the Aspenwood Lane box can be increased by eliminating a drop at the boxes inlet. With the increased slope, the freeboard available through the box can be improved by approximately 7 inches.

For the purpose of this study, the maximum Basin outflow is considered to be 400-cfs, which anticipates no improvement to the downstream channel. If the slope of the downstream channel were increased, the recommended maximum Basin outflow would be 450-cfs.

ES-4 HYDROGEOLOGIC CONDITIONS

In August of 2003, the County of Orange Materials Laboratory conducted a geotechnical investigation of the Haster Basin site. During that investigation, groundwater was found at approximately elevation 93.0 feet, which is 5.5 feet higher than the bottom of the Basin. The finding was significant in that the previous studies had developed concepts to improve Haster Basin predicated upon the full Basin depth being available.

To confirm the presence of groundwater, the County authorized a hydrogeologic study of the site by Ninyo and Moore Geotechnical in June, 2004. Ninyo and Moore drilled monitoring wells at the

Basin, and up gradient and down gradient from the Basin. Groundwater data from existing monitoring wells in the area were also reviewed.

Ninyo and Moore concluded that there was a shallow aquifer underlying Haster Basin, which is perched on a clay lens approximately 45 feet below the ground surface. Ninyo and Moore estimated the groundwater surface elevation at Haster Basin to be 92.0 feet.

Groundwater level measurements were continued through the winter season of 2004-2005, during which record rainfall was recorded in Southern California. The level measurements showed that the groundwater level had increased approximately 4 feet to elevation 96.0 feet.

To address the high groundwater issue, a number of alternatives were considered. These included:

1) Widen the Basin to increase storage volume.
2) Perpetual dewatering of the Basin.
3) Install sheet piles to cut-off groundwater from flowing into the Basin.
4) Install a liner on the Basin bottom.

Of the alternatives considered, widening the Basin by modifying the proposed grading was chosen as the most feasible to implement. It was further determined that the grading plan would be predicated upon the normal groundwater level being at 92.0 feet. Dewatering would be conducted during periods of higher than normal groundwater levels to lower the Basin to the elevation necessary to provide the required storage volume for the project (elevation 92.0 feet).

To confirm this approach, a meeting was held with the Orange County Water District (OCWD) in May, 2005 to discuss the proposed Basin operation. Representatives from OCWD expressed no concern over the proposed option, and stated that the pumping fees which normally would be charged would not be assessed for this application. OCWD, however never provided a written response confirming these statements.

ES-5 BASIN GRADING AND HYDRAULICS

ES-5.1 Hydrology

The hydrology for the project was prepared by the County in September 2001. That study provided the expected value peak inflow to Haster Basin for 2, 5, 10, 25, 50 and 100-year storm events. It utilized the AES rational method hydrology, and flood routing programs, with a single area hydrograph. The results presented in the study for the 100 year, expected value, multiday storm are summarized below.

	Day 1	Day 2	Day 3
Peak Run-Off	280-cfs	808-cfs	2192-cfs
Run-Off Volume	84 ac-ft	220 ac-ft	554 ac-ft

AKM verified the results of the County's hydrology by using the input data from the study and running the data through the LAPRE, and HEC-1 programs.

The results of AKM's study closely replicated those contained in the County's report, and is therefore considered to be an accurate representation of the Haster system, and suitable for use in analyzing the various Basin alternatives developed in this report.

ES-5.2 Grading

Of the three grading alternatives proposed (Dry Basin Bottom, Dry Basin Bottom with a Small Upper and Lower Lake for Water Quality Purposes, and Wet Basin Bottom), the County chose the Wet Basin Bottom because it provides the greatest water quality benefit and would continue a popular feature already present at the park.

To increase the storage volume of the Basin, it will be widened, because it cannot be deepened due to the high groundwater level. The proposed grading will maintain the current Basin bottom of 87.0 feet and feature side slopes of 4:1 closer to the water and 2:1 closer to the pedestrian walkway. The proposed grading will increase the total storage volume to approximately 207 ac-ft (at elevation 108.0 feet), which is 54 ac-ft more than is currently available. The Basin volume between elevation 92.0 feet and 87.0 feet will be dead storage used for water quality purposes.

The grading will result in approximately 125,000-cy of earthwork (100,000-cy cut; 25,000-cy-fill). Usable park area will be reduced by about 37% as a result of the grading. The proposed grading plan is shown on Figure ES-2.

ES-5.3 Hydraulics

The inflow hydrographs were routed through the proposed Basin grading and pump station using the HEC-1 program. The analysis showed that the pump station would empty the Basin of the first two days of runoff prior to the end of each of those days. The maximum Basin water surface elevation of 107.9 feet occurred on the third day of the storm, which meets the project's criteria of 108.0 feet maximum.

The width of the proposed spillway is 25 feet. A hydraulic simulation showed that the highest Basin elevation resulted with the lead pump failed and was 110.9 feet. The corresponding flow through the spillway is 198-cfs. The hydraulic analysis confirms that the proposed 25-foot spillway will meet the criterion established for this project.

ES-5.4 Impact on Trees

About 98 of the existing 301 trees in the park will have to be removed due to the proposed grading. However, many of the trees will be replaced after construction.

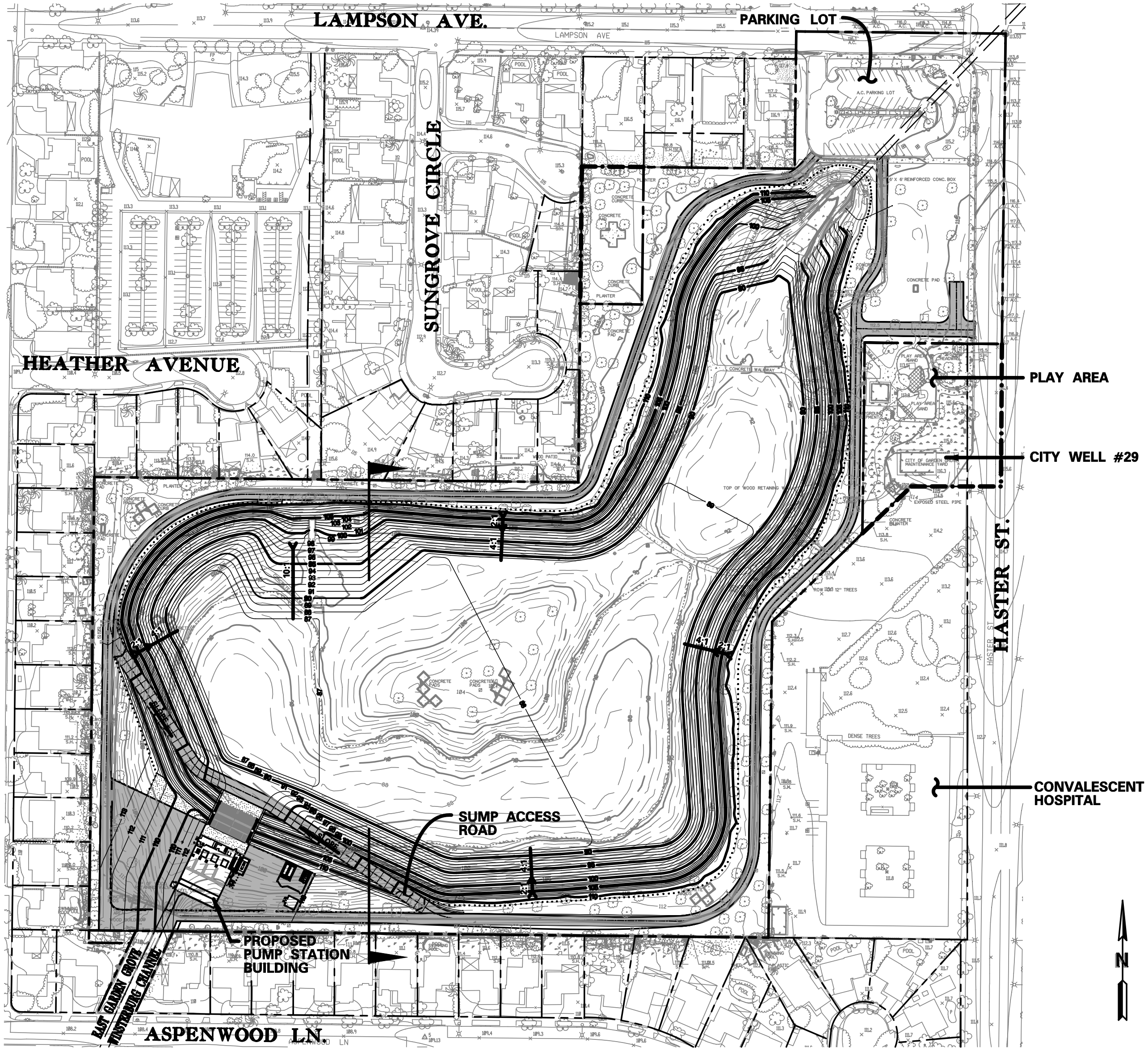

Figure No. ES-2

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ORANGE COUNTY PUBLIC FACILITIES & RESOURCES DEPARTMENT

HASTER BASIN/TWIN LAKES PARK PUMP STATION

HASTER BASIN
PROPOSED BASIN GRADING

$FILE$ 3/30/2010

ES-6 GEOTECHNICAL INVESTIGATION

A geotechnical investigation was prepared in July 2005 to provide recommendations for the structural design of the pump station, and to assess the stability of the proposed 2:1 slopes included in the Basin grading design. A total of four (4) soil borings, approximately 30 feet in depth, were conducted as part of this investigation.

ES-6.1 Soils

Soils underlying the site are alluvial fan deposits consisting primarily of gravel, sand, and silt.

ES-6.2 Seismicity

The nearest active fault to the site is the Newport-Inglewood fault located approximately 9 miles away. The peak ground acceleration that may be expected during an earthquake is 0.38-g. A computer analysis showed that soils located between the depths of 14 feet and 23 feet and susceptible to liquefaction. Post-earthquake settlement for the sump structure is estimated to be 1-inch or less.

ES-6.3 Slope Stability

The slope stability analysis showed that the 2:1 slope proposed in the grading plan has a factor of safety of 1.5 and 1.1 under static and pseudo-static conditions. These values are within accepted geotechnical practices and in accordance with County of Orange guidelines.

ES-7 PUMP STATION DESIGN

The purpose of the pump station is to evacuate as much water from the Basin as the downstream channel will carry and therefore increase the available storage capacity of the Basin during a storm. Additionally, without the pump station maintaining the Basin water surface below elevation 108 feet, the upstream drains could not convey the 100-year storm flow without causing flooding in their tributary areas.

ES-7.1 Pump Selection

The basic criterion for selecting pumps is that a total pump station capacity of 400-cfs is required. After considering a 7-pump, 2-pump, 4-pump, and 3-pump system, it was determined that a 3-pump system strikes the right balance among building footprint, equipment size, and cost.

The pumps selected must be able to operate properly at all anticipated Basin levels. Pumps which operate outside the limits of their performance curve can be subject to severe damage from cavitation and unbalanced forces on the impeller. To ensure that the pump will always operate within an acceptable range, a seal weir structure is recommended on the pump outlet to control pumping head. This will increase the static lift required and therefore keep the pump running within an acceptable performance range. A disadvantage of the seal weir is that it increases the required pumping power by 100-horsepower.

Three Johnston 48 PO Propeller pumps are recommended for the project. The pump design conditions are 60,000-gpm (135-cfs) at 23 feet TDH, 390-rpm. Maximum required horsepower is 500.

The submergence of a pump is the depth of water above the suction bell. The manufacturer of Johnston 48 PO pump recommends this to be 140 inches to prevent vortices from forming. However, this value can be lowered by using a suction umbrella which reduces the inlet velocity to the pump. A 104-inch diameter suction umbrella will lower the inlet velocity to around 2 ft/sec, which will allow the required submergence to be reduced to 80 inches.

ES-7.2 Natural Gas Engines

The prime mover for each pump will be a natural gas engine. The criteria for engine sizing is as follows: it will be a heavy duty type; the speed will be limited to 1,200-rpm maximum; the maximum horsepower will be loaded below 70% of the maximum brake horsepower available; the fuel will be natural gas with an LPG back-up system; and the cooling system will feature a sump mounted heat exchanger and City water cooled auxiliary heat exchanger.

A Waukesha L5790G naturally aspirated engine is recommended for the project. The engine is capable of developing 750-hp at 1,200-rpm.

The primary cooling system for the engine will be a sump mounted heat exchanger. The heat exchanger is designed to reduce the coolant temperature to 189°F. In series with this unit is an auxiliary heat exchanger which uses City water to provide additional cooling of the engine jacket water if the inlet temperature is above 190°F or if there is no water in the sump.

The engines also feature an engine jacket heater, an engine lube oil system, a power Take-Off clutch, batteries and charging system, an engine exhaust system with catalytic converter and air/fuel ratio controller.

The engines will be equipped with regulators, a fuel transfer switch, and carburetion suitable for LPG or natural gas service. There will be propane storage tanks sized for a minimum of a 12-hour fuel supply. In accordance with the LPG code, tanks must be located a minimum of 25 feet from the pump station building and be separated a minimum of 3 feet. The tanks will be located outside, in parallel, on a concrete pad, and enclosed with an 8-foot high steel picket fence.

ES-7.3 Sump Design

A good sump design is important in order to avoid conditions which have a negative impact on pump performance caused by poor hydraulic conditions. To ensure proper pump performance, the sump will be designed in accordance with the criteria established by the Hydraulic Institute of Standards. These standards seek to optimize the approach flow pattern so that cross-flows or asymmetric flow patterns in the vicinity of the pump are minimized or eliminated. All dimension recommendations are based on the suction bell diameter of the pump used. The overall length of the sump, including the apron, is 106 feet and the width is 64'-8". The sump incorporates 5 bays: three 13'-4" wide pump bays; one 6-foot wide sump pump bay; and a stairwell leading from the pump room to the sump. The proposed pump station sump is shown on Figure ES-3

ES-7.4 Trash Rack

A trash rack is provided to protect the pumps from large trash and debris. The trash rack will be constructed of stainless steel and will be of similar design to that provided for the County's Rossmoor and Los Alamitos pump stations.

ES-7.5 Pump Station Layout

The overall dimensions of the building are 71'-4"(W) by 68'-0"(L) by 38'-2"(H). It includes the engine room, office, electrical room, restroom, and stairwell.

The engine room layout includes a minimum of 6 feet clearance between adjacent equipment and the walls to allow for equipment disassembly and maintenance. A 15'-4" wide truck access aisle is provided to allow for the engines to be removed by flatbed truck. Approximate dimensions of the engine room are 53'-4"(W) by 63'-4"(L) by 21"-6" (H).

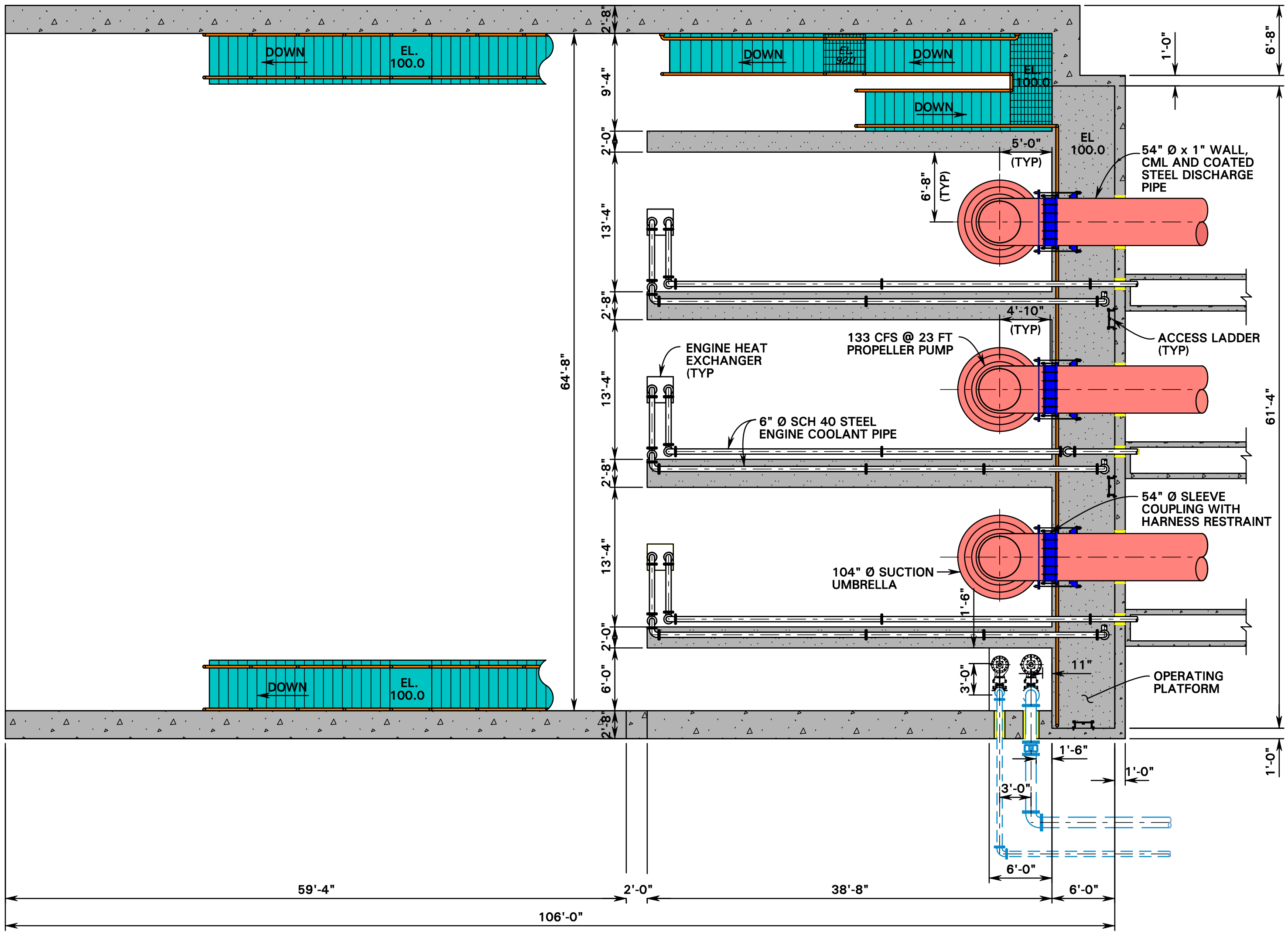
The office will be heated/cooled by a small ½ ton heat pump, and will include a telephone, and a desk. An ADA compliant restroom is located adjacent to the office and has approximate dimensions of 8'(W) by 6'(L) by 10'(H). The electrical switchgear for the pump station is located in this room, as are the control panels for each pump engine. There is a window to the engine room for visually monitoring the engines. Approximate dimensions of the office are 24'-8"(L) by 10'-0"(W) by 10'-0"(H)

The stairwell provides access to the sump floor and roof. Approximate dimensions of the stairwell are 11'-4"(W) by 27'-4"(L).

Figures ES-4 and ES-5 show the proposed pump station layout.

ES-7.6 Building Architecture

The pump station will be located in a park setting, adjacent to a residential community. The architectural design must be compatible with both themes while still maintaining the necessary functionality required for a pumping station. A Spanish style architecture was chosen for the building as being most compatible with the area. The design will feature: masonry walls with a stucco exterior; foam trim to simulate windows and provide wall relief; wood clad metal doors; Spanish tile roof with shaped rafter tails at the eaves; lantern style exterior lights; and a fountain. A rendering of the proposed building is shown on Figure ES-6.



SUMP PLAN

SCALE: 1/16" = 1'-0"

Figure No. ES-3

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ORANGE COUNTY PUBLIC FACILITIES & RESOURCES DEPARTMENT

HASTER BASIN/TWIN LAKES PARK PUMP STATION

SUMP PLAN

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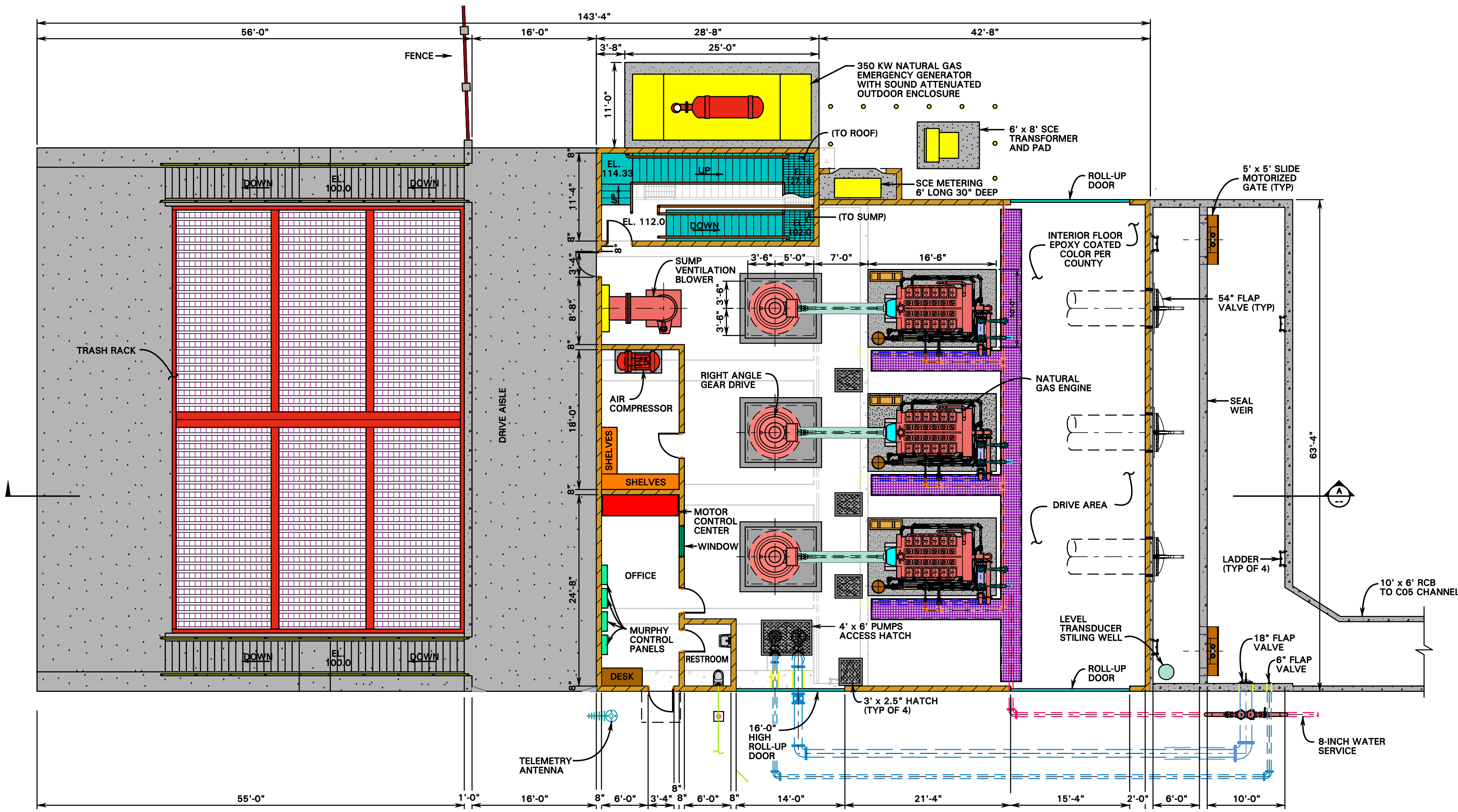

PUMP STATION FLOOR PLAN

SCALE: 1" = 20'-0"

Figure No. ES-4

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ORANGE COUNTY PUBLIC FACILITIES & RESOURCES DEPARTMENT

HASTER BASIN/TWIN LAKES PARK PUMP STATION

PUMP STATION FLOOR PLAN

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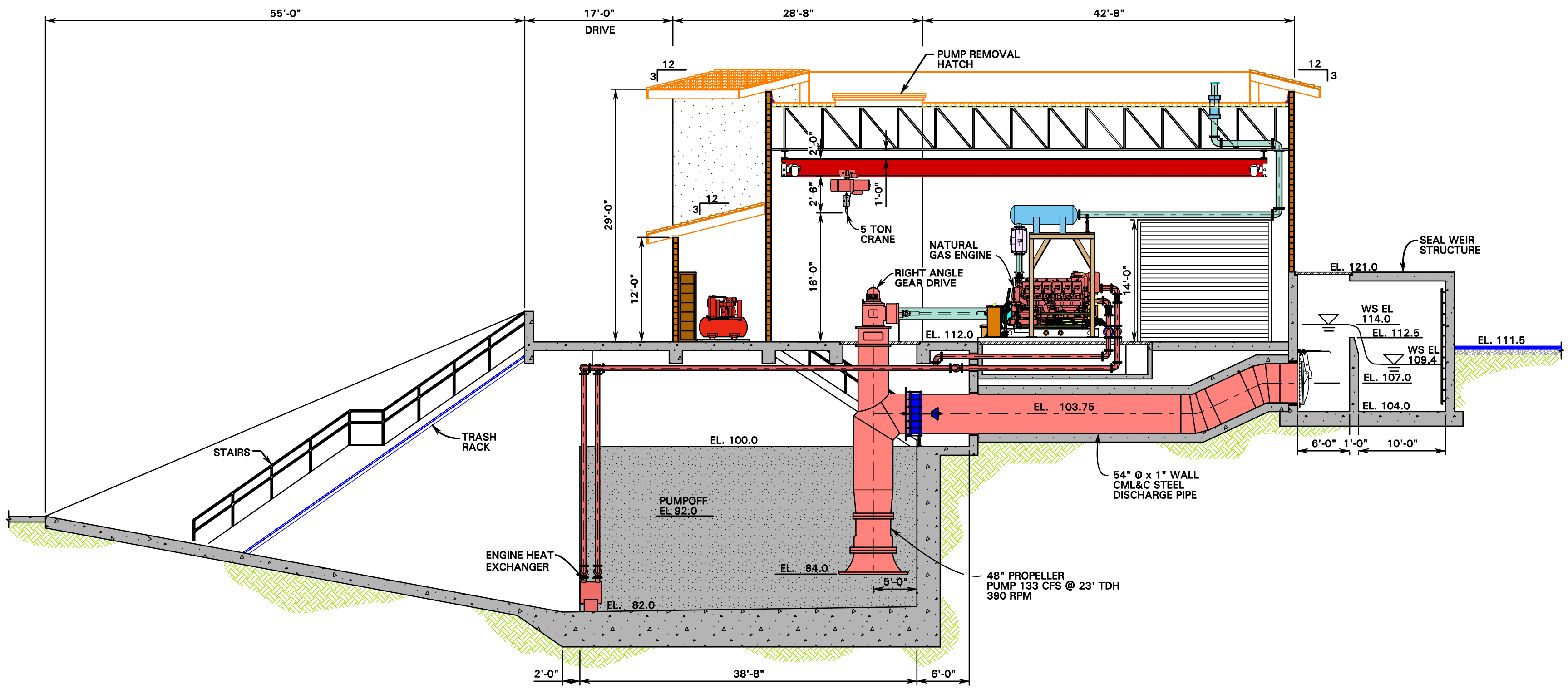

PUMP STATION SECTION

SCALE: 1" = 20'-0"

Figure No. ES-5

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

PUMP STATION SECTION

$FILE$ 3/30/2010

HASTER RETARDING BASIN PUMP STATION

COUNTY OF ORANGE

GARDEN GROVE, CALIFORNIA

KAA

KNITTER & ASSOCIATES

2008009 03/12/2008

Figure No. ES-6

AKM

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ORANGE COUNTY PUBLIC FACILITIES & RESOURCES DEPARTMENT

HASTER BASIN/TWIN LAKES PARK PUMP STATION

RENDERING OF PROPOSED
PUMP STATION

$FILE$ 3/30/2010

ES-7.7 Structural Design

The structure shall be designed in accordance with the current edition of the American Concrete Institute Building Code Requirements for Reinforced Concrete. The 28-day compressive strength of the concrete shall be 4000-psi. Structural steel design shall be in accordance with the specifications set forth in the current edition of the Manual of the American Institute of Steel Construction.

ES-7.8 Noise and Vibration Mitigation

Since the pump station will be located in a park close to single family residences, it will be important to control the noise and vibration generated by the pumps and engines at the station. A noise study designed to address potential impacts to nearby homes will be conducted after the Preliminary Design Report for the project is adopted by the County. However some features which will be incorporated in the project's design will include:

- Installation of sound panels on walls and ceiling
- Installation of acoustic doors and louvers
- Solid grouting of pump station block walls
- Direct louvers, doors and engine exhausts away from homes
- Provide super critical silencer for generator and engine exhausts
- Provide sound attenuated outdoor enclosure for emergency generator

Any additional recommendations contained in the project's noise study will also be incorporated into the facility design.

Excessive vibration can be detrimental to the pump station building structure, piping and equipment, and adjacent residences. Typical sources of vibration in a pump station include: reciprocating machinery such as engines or compressors and out of balance centrifugal equipment such as fans or pumps. The following vibration control measures will be included in the project: isolating the engine mounting bases from the floor; installing vibration isolators on the Fan and Genset; operating the pump close to the Best Efficiency Point; limiting velocities in the piping system; and designing the building to avoid resonance vibration.

ES-7.9 Security Systems

Security provisions will be installed at the proposed pump station to protect the facility from intrusions and vandalism. These measures are as follows: minimizing the accessibility to doors and louvers by the general public; using anti-graffiti paint; installing security lighting; and installing an intrusion system on the doors.

ES-7.10 Electrical System

The electrical installation for all work in the sump will be in accordance with a Class 1 Division 2 hazardous location as defined by NFPA 70 (National Electric Code; NEC).

The electrical load requirement for the pump station is 350-amps.

Southern California Edison (SCE) requires that the service meter be located in its own room for the protection of Edison employees reading the meter. As such, a small alcove has been designed on the east side of the building to house the Edison meter, main disconnect switch, and automatic transfer switch for the emergency generator.

The motor control center will be located in the pump station office and will including starting equipment for the sump pumps, ventilation fan, and air compressor. The length of the motor control center will be about 10 feet.

A 350-kW, natural gas emergency generator will be provided to maintain power to lighting and ventilation systems during a commercial power outage. The unit will be installed outside in a weather resistant, sound attenuated, lockable enclosure.

ES-7.11 Pump Station Control System

Pump operation will be controlled by a level control system. There will be a primary and back-up level transducer in the sump, as well as a float switch to affect emergency operation in the case of transducer failure. The seal weir structure will also have a level transducer and float switch to control the station output to a maximum of 400-cfs.

The pump station will incorporate a Murphy-type engine control system consisting of a dedicated central controller and individual engine controllers. The central controller will be programmed to call and shut down pumps, as well as communicate with the County's SCADA system through a spread spectrum radio system. The engine controllers will monitor and control their dedicated engine, based upon information provided by the central controller.

ES-7.11 Additional Equipment/Features

The right angle gear drive is bolted to the top head of the pump and is used to convert the horizontal rotation from the engine shaft drive to vertical rotation of the pump shaft. An Amarillo Gear Company Model P8 right angle gear drive is recommended for the project.

The sump pump is used to empty the pump station sump at the end of a storm, pump low flows generated from dry weather urban runoff, and pump low level precipitation events. One 500-gpm and one 3,000-gpm capacity pump will be used, both will be recessed impeller pumps.

A 5-ton bridge crane will be provided in the pump station for use in maintaining the engines, right angle gear drive, and removal of the sump pumps. A craneveyor Z-10 Series is recommended, with a Yale wire rope hoist and motorized trolley.

A 17'(W) by 67'(L) seal weir will be required on the discharge of the pumps to control pumping head when the water level in the Basin is high. To create a water surface elevation of 114.0 feet at a pumping rate of 400-cfs, the top of the weir must be set at elevation 112.5 feet.

The County has requested a 15-foot by 15-foot hazardous material house to be located in the vicinity of the pump station. It will be used for storing engine oil, gear oil, and an additional air compressor.

A sump ventilation fan will be provided that blows air at a rate of 17,000-cfm, which is equivalent to an exchange rate of 12 times per hour. The recommended fan is an Aerovent Model 38W718 vane axial fan.

Roof-mounted exhaust fans will be provided with capacity sufficient to produce 30 air changes in the pump room. A total of 10 fans will be provided, each with a rated capacity of 4,000-cfm at 0.25-inch W.C. pressure. The recommended roof fan is Greenheck G-180-B.

To measure rainfall at the site, a tipping bucket-style rain gauge will be installed on the roof. The recommended rain gauge is a Nova Lynx 260-2500.

Service air for pneumatic tools will be provided at the facility. The air compressor will be a rotary screw type with a capacity of 68-cfm at a discharge pressure of 100-psi. The recommended unit is an Atlas Copco GAU 15-100.

Level transducers will be installed in the sump and outlet structure. They will be provided in pairs for redundancy, and will be installed in a stilling well. The recommended level transducers are Rittmeyer 2-wire MPU.

A gas detector will be installed in the engine room to measure for the presence of natural gas or LPG.

ES-8 SITE IMPROVEMENTS

ES-8.1 Site Access

Currently, vehicles can access the site through a 25-foot wide paved area adjacent to the outlet channel or the parking lot in the north east corner. Once inside the park, there is an 8-foot wide paved road around the perimeter of the lake. The city has requested that the entrance on Aspenwood Lane be used by large maintenance vehicles only 2 to 3 times per year. Due to the restrictions on the use of Aspenwood Lane, a new access point will be created on Haster Street north of the children's play area. This road will feature a 20-foot concrete driveway, a lockable swing gate, and a paved turn-around area for cars inadvertently entering the road.

ES-8.2 Perimeter Road

Due to the poor condition of the current 8-foot perimeter road, a new 10-foot wide a.c. paved perimeter road will be constructed. The paved road will double as a path for bikes. Directly adjacent to the paved road will be a 5-foot decomposed granite walking path. Its alignment is generally in the same location as the existing road.

ES-8.3 Water Quality

The County's Drainage Area Management Plan requires all projects to implement Best Management Practices (BMP) to reduce pollutants from urban run-off to the Maximum Extent Practicable (MEP). BMP's to be considered for implementation into the project will be a water quality wet pond for heavy metal and sediment control and trash racks.

While this report does provide recommendations for BMPs to be implemented by the project, it is not intended to be a water quality management plan. The preparation of such a plan is outside of AKM's scope of work and is to be completed by the County, along with the environmental documentation, and resource agency permits which are also necessary for the project.

A trash rack will be installed at the pump station to prevent trash that may have been blown into the Basin from being pumped downstream. The screen would have openings of 4-inches by 15-inches uniformly throughout the trash rack. This is the same size as the trash racks designed for the Los Alamitos and Rossmoor Pump Stations.

Paved areas will be graded and curbed to prevent runoff from escaping the site. Yard drains with filtered inserts will be provided to capture these flows. Concentrated flows from the pump station roof will also be filtered prior to being discharged into the pump station sump. Porous pavement is not considered feasible because of the maintenance vehicle weights which will be traveling over the pavement.

To prevent the deposit of heavy metals into the water from being pumped, only stainless steel, aluminum, or epoxy-coated steel will be used in the design of the pump station sump structure.

ES-8.4 Site Restoration

The proposed flood control facilities at Haster Basin will significantly impact many of the existing park improvements, removing many trees, and most of the picnicking facilities. The County, recognizing the importance of the park at the Haster site, is committed to restoring the recreational facilities which are currently present at the site after the completion of the pump station project.

Site restoration of Haster Basin will include: hydroseeding the regarded slopes with native vegetation, possibly planting new trees and installing irrigation between the road and the property line, construct a 15-foot wide pathway around the Basin, new steel fencing at the top of the Basin slope, protecting in place the existing playground and restroom, and replacement of benches and picnic tables that are removed by construction activities. The proposed restoration plan is shown on Figure ES-7.

ES-8.5 Pump Station Access Road

A concrete access road will be constructed to the front of the sump structure to allow truck access to the pump station trash rack. The road is graded at an 8% slope, is 20 feet wide, and has a 6-inch curb. At the sump structure, the road will be at elevation 92.0 feet amsl, which will likely be underwater most of the time. The hydraulics of the Basin require this result; however, the Basin can be pumped down when access to the trash rack is needed.

ES-8.6 Flood Wall

A flood wall will be constructed around the Basin spillway area to provide additional protection for the homes in the area. The elevation of the top of the wall should be at 114.0 feet amsl. Approximately 500-LF of wall is proposed.

ES-8.7 Basin Fence

The City would like a fence to be installed around the Basin to protect park users from accessing the lake. The fence design will be in compliance with the City of Garden Grove Municipal Code for swimming pools, which calls for a minimum height of 60 inches and no more than a 2-inch vertical clearance from the ground.

ES-8.8 Utility Services

Water, sewer, natural gas, telephone, and electrical services will be required for the pump station

- *Water* – The total water demand is expected to be about 520-gpm. A 3-inch meter service will be obtained near the City's water well to provide irrigation for the landscaped areas. A 4-inch meter service will be obtained for the pump station from an existing 8-inch line in Aspenwood Lane. This connection line will be located in the road adjacent to the outlet channel

- *Sewer* – A sewer service will be required for the toilet and sink. A 4-inch sewer lateral will be constructed in the road adjacent to the outlet channel and connect to the existing City of Garden Grove 8-inch sewer in Aspenwood Lane.

- *Natural Gas* – Natural gas service will be required for the engine pump drivers and the emergency generator. The service should be sized to deliver 15,000,000 BTU/hr of gas to the pump station. SCG service coordinator, Robert Ozuna, stated that the 3-inch medium pressure gas line (60-psi) in Aspenwood Lane would be capable of supplying the project.

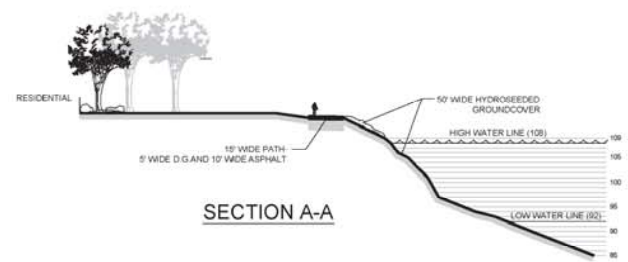
HYDROSEED MIX

NATIVE WILDFLOWER

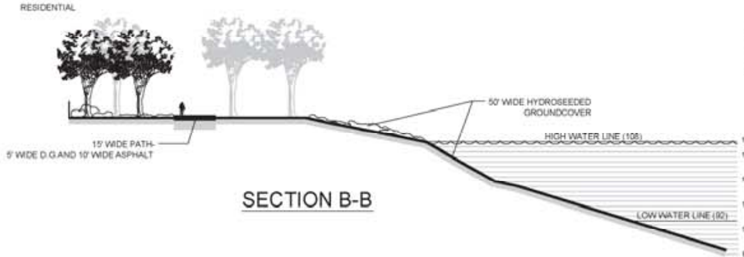
NATIVE WILDFLOWER SPECIES IN MIX

Firecracker penstemon (Penstemon eatonii) 8%
Palmer penstemon (Penstemon palmeri) 7%
Desert marigold (Baileya multiradiata) 3%
Mexican hat (Ratibida columnifera, red) 8%
Yellow prairie coneflower (Ratbida columnifera) 8%
Purple Aster (Aster bigelovii) 4%
Blanketflower (Gaillardia aristata) 8%
Firewheel (Gaillardia pulchella) 8%
Blue flax (Linum lewisii) 8%
Arroyo lupine (Lupinus succulentus) 5%
Arizona lupine (Lupinus arizonica) 2%
Blackfoot daisy (Melampodium leucanthum) 5%
Showey goldeneye (Viguiera multiflora) 8%
Black-eyed Susan (Rudbeckia hirta) 5%
Plains coreopsis (Coreopsis tinctoria) 8%
California poppy (Eschscholzia calif.-naturalized) 5%

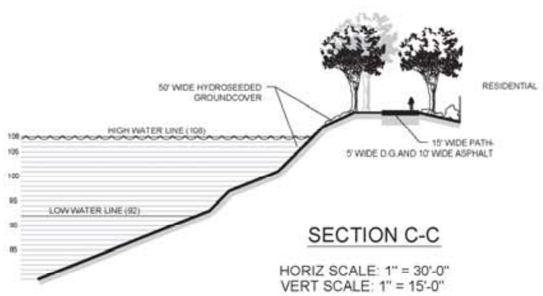
Purity: 98.44%
Germination: 82%
Crop: .02%
Weed: .01%
Inert: 1.53%
Noxious: None found
Tested 9/15/05



SECTION A-A

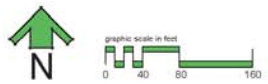


SECTION B-B



SECTION C-C

HORIZ SCALE: 1" = 30'-0"
VERT SCALE: 1" = 15'-0"



PARK PLAN-ALTERNATIVE A
HASTER BASIN

David Volz Design
Landscape Architects and Park Planners

July, 2007

Figure No. ES-7

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ORANGE COUNTY PUBLIC FACILITIES & RESOURCES DEPARTMENT

HASTER BASIN/TWIN LAKES PARK PUMP STATION

ALTERNATIVE 4A
CONCEPT PLAN

$FILE$ 3/30/2010

- *Power* – Three-phase, 480 volt electrical service will be required for the project. The estimated electrical load is 350-amps. The SCE service planner, Jeff Gilbert, has indicated that power may be obtained from the pole located adjacent to the Aspenwood entrance access road.
- *Telephone* – A standard dial-up telephone service will be obtained for the project. Service is available from a pole located behind the properties at 12771 and 12871 Aspenwood Lane. As requested by the County, 6-pairs of phone lines will be provided.

ES-9 CONSTRUCTION ISSUES

ES-9.1 Phasing of Work

The project will be presented as one bid package. The first phase of construction would consist of all sitework and grading. Immediately following would be the second phase which would include construction of the pump station.

ES-9.2 Grading and Sitework

It is projected that the grading and sitework would begin in April of 2010 and would be completed by January of 2011.

Most of the park would remain closed during this portion of the construction. The area could be reopened after the grading is complete, the walkway built, and landscaping restored.

Dewatering the Basin will be an important construction issue. Above the groundwater level, the existing lower lake pump station can be used to evacuate the water. Below the groundwater level, it is assumed that a trench could be built in the bottom of the Basin and sump pumps used to pump out the groundwater.

The size of the pump which would be needed has not yet been determined. Test pumping of monitoring wells which have been already installed will be required to determine dewatering rates. *It is strongly recommended that the County authorize this study.*

ES-9.3 Pump Station Construction

Construction of the pump station would occur immediately after completion of the grading and sitework phase, in January 2011. It is estimated that the pump station would be completed in February 2013.

Shoring and dewatering will be a significant issue. It is envisioned that sheet piles would be driven into a clay lens located approximately 45 feet below the site to create a cofferdam. Dewatering would occur inside the shored area to prevent the drawdown of the groundwater level in the surrounding area and minimize potential damage to homes.

It is recommended that during construction of the pump station, a monitoring program be implemented to determine if settlement of the surrounding ground is occurring. The program will consist of the installation and monitoring of seismographs, monitoring wells, inclinometers, and settlement points. Readings from each of these devices will be taken daily. Vibration, ground movement, or settlement observed in excess of predetermined threshold will result in construction being halted until a mitigation plan can be developed by the Contractor which addresses the condition.

ES-10 CONSTRUCTION COSTS

Estimated construction cost for the project is presented in the table below. The estimate is based upon an Engineering News Record Index of 9183 (February 2008), and includes a 15% factor for contingencies.

SUMMARY OF ESTIMATED CONSTRUCTION COSTS	
Site Grading =	$7,417,500
Site Restoration =	$996,209
Pump Station Construction =	$11,721,898
Site Improvements =	$2,205,882
Estimated Construction Cost (2008 DOLLARS) =	$22,341,489
Inflation (16%) =	$3,574,638
Estimated Construction Costs, Grand Total (2011 DOLLARS)	**$25,916,127**

Section 1
INTRODUCTION

1-1 PURPOSE

Haster Basin (Basin), Orange County Flood Control District Facility C05B01, is a small retarding basin located on a 22.4 acre site, at the intersection of Lampson Avenue and Haster Street, in the City of Garden Grove (see Figure 1-1). The Basin is owned and operated by the Orange County Flood Control District (District) but also serves as a community park (Twin Lakes Park), operated by the City of Garden Grove.

The purpose of the Basin is to attenuate peak flows from the upstream drainage area, by storing water in excess of the downstream channel capacity. Two regional drains discharge directly to Haster Basin. The East Garden Grove Wintersburg Channel (Facility No. C05) is a 9-foot by 6-foot reinforced concrete box (RCB) which enters the Basin at its northeast corner. The 100-year expected value flow tributary to this facility is 1,573-cfs. The Oertley Storm Drain (Facility No. C05 P19) is a 96-inch reinforced concrete pipe (RCP) with a tributary 100-year expected value flow of 700-cfs. Water outlets from the Basin through the downstream continuation of the East Garden Grove-Wintersburg Channel (Facility No. C05), located in the southwest corner of the site. The facility, is a 10-foot wide by 5.5-foot high RCB, that has a reported design capacity of 400-cfs.

The existing facilities were designed in the early 1960's to convey 65% of the 25-year peak discharge, in accordance with the hydrology standards of the time. The County's current hydrology manual, adopted in 1986, requires 100-year return frequency flood protection for all habitable structures. Facilities which do not meet the 100-year flood protection requirement are considered substandard and are programmed by the County for improvement. Haster Basin's existing capacity is approximately equivalent to a 5-year storm.

The most recent planning study of the entire East Garden Grove-Wintersburg Channel system was completed in 1994. The 1994 Project Report for the East Garden Grove-Wintersburg Channel prepared by Williamson & Schmid recommended improvements to the C05 system to bring it into compliance with the County's requirement for regional flood protection. It also analyzed alternatives for attenuating the peak inflow at the Basin so that the maximum downstream channel capacity would not be exceeded. The Project Report recommended that a 420-cfs pump station be constructed at Haster Basin to maintain adequate useable flood control volume, by pumping out the stored flows below the outlet channel's invert.

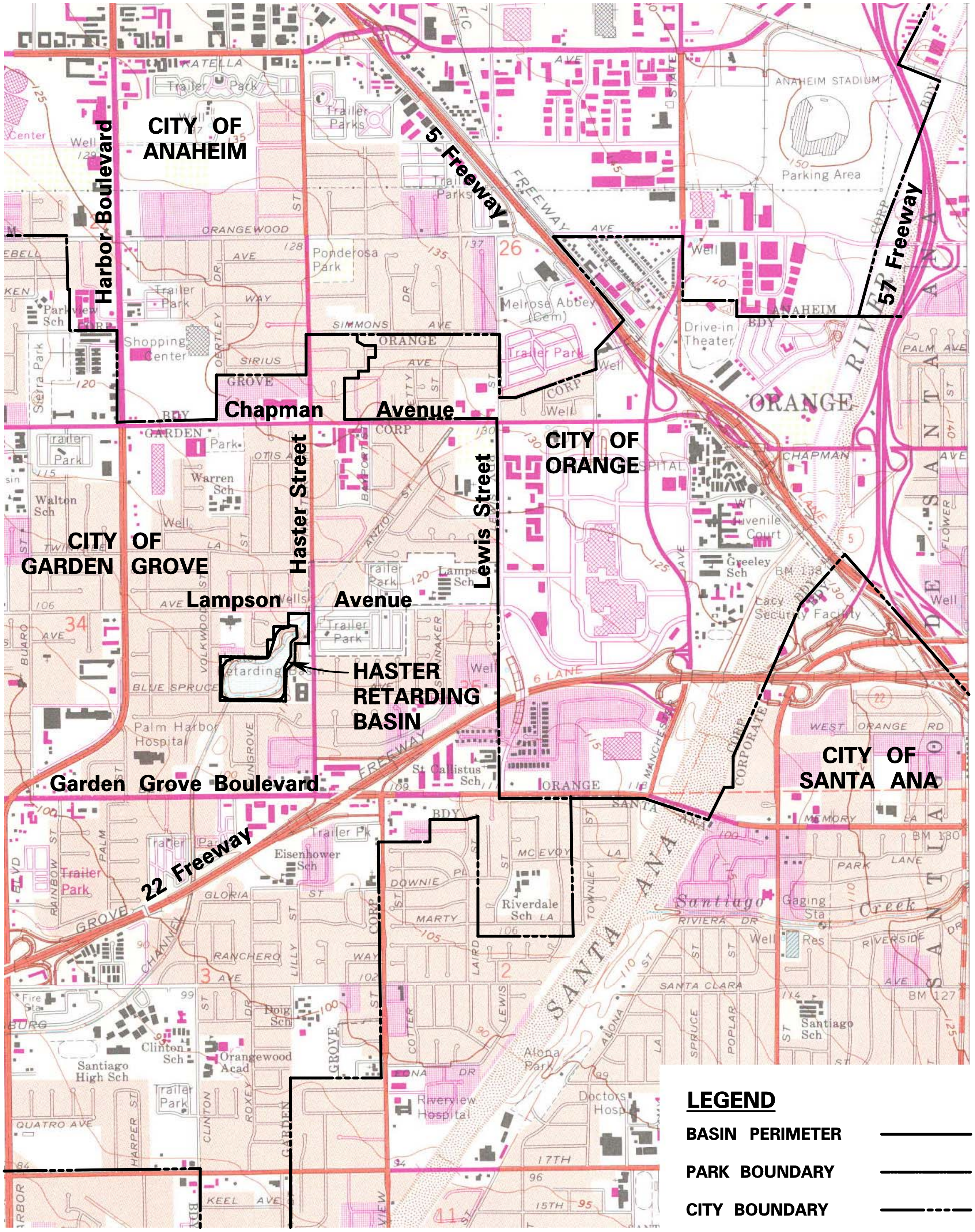

Figure No. 1-1

N

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ORANGE COUNTY PUBLIC FACILITIES & RESOURCES DEPARTMENT

HASTER BASIN/TWIN LAKES PARK PUMP STATION

HASTER BASIN LOCATION IN CITY OF GARDEN GROVE

$FILE$ 3/30/2010

In 2001 CH_2MHill prepared a Preliminary Design Report to re-evaluate the recommendations of the Project Report and advance them to pre-design stage. The CH_2MHill report recommended regrading of the Basin and construction of a 375-cfs pump station.

The purpose of this report is to re-evaluate the recommendations of the CH_2MHill study and provide a framework for advancing the project to final design. The completed project will include regrading the Basin and the installation of a 400-cfs capacity pump station. The maximum Basin water surface elevation generated by a 100-year expected value storm will be limited to 108.0 feet to ensure consistency with the City of Anaheim's hydraulic calculations for the upstream storm drain system, and to eliminate a levied condition at the site.

1-2 PREVIOUS STUDIES

Several studies have been prepared by the County and City of Anaheim addressing the limitations of the Haster Basin System. These are as follows:

A. Project Report for the East Garden Grove-Wintersburg Channel (Facility No. C05), Prepared by Williamson and Schmid, Dated 1994

The report recommended improvements to the Haster Basin System to reduce the 100-year expected value peak outflow from 2,200-cfs to a maximum downstream channel capacity of 450-cfs. Specifically, improvements which were recommended that directly impacted Haster Basin included:

- Enlargement of the upstream reach of the East Garden Grove-Wintersburg Channel from a single 9-foot by 6-foot RCB to a double 9-foot by 6-foot RCB.
- Construction of a 420-cfs pumping facility consisting of seven (7) 60-cfs capacity pumps, staged to start at 1-foot intervals, up to the invert elevation of the outlet channel. Pumps would be turned off in 1-foot intervals as the water level continued to decrease in the Basin. No regrading of the Basin was proposed, however the entire volume of the Basin was assumed to be available above the base elevation of 87 feet (no dead storage).

The study also investigated the alternative of constructing a gravity drain, near the bottom of the Basin, aligned parallel to the downstream channel, as a means of eliminating the need for a pump station. Approximately 2,700 LF of 108-inch RCP would be required, daylighting into the East Garden Grove-Wintersburg Channel near the Garden Grove Freeway. The study concluded that the alternative was not feasible as there was not sufficient right-of way to construct such a facility.

Haster Basin Outflow

It is pointed out that the Haster Basin design outflows cited in various sections of the Project Report are inconsistent. The hydrologic studies were based upon a maximum basin outlet flow of 450-cfs, as shown in the footnote of "Table 5.1 Summary of Discharges for C05" of the Project Report. Section 1, Executive Summary of the Project Report also describes the maximum basin outflow on page 4, third paragraph as "A maximum basin outflow of 450 cfs (equivalent to the capacity of the existing outlet) was assumed for evaluation of the downstream C05 Channel, and improvements to the basin were investigated which would limit the ultimate outflows to this level. Additional improvements required to reduce the outflow below this level were determined to be not cost effective." Subsection 4.8.1, Haster Basin states "***Outflow is controlled by a 5.5'H x 10'W RCB***", "***The hydraulic constraints on the outlet culvert do not permit the outflow discharge to exceed about 400-cfs without going over the spillway***", "***In order to maintain the maximum outlet discharge of 450-cfs assumed in the Project Report Hydrology (based on downstream channel capacity, see Section 5.2), A series of pumps could be designed which would be turned on and off at two stages within the basin routing. For this Project Report a series of seven 150 HP (60-cfs) pumps were analyzed. Each pump would be successively turned on at 1 foot stage intervals until the elevation of the existing outlet is reached. As flows outlet through the culvert by gravity, the pumps would then be turned off at 1 foot stage intervals such that the combine discharge does not exceed 450-cfs***", and "***Alternate pump configurations and controls could be used and should be investigated prior to final design***".

Table 3.1 C05-Existing Channel Facilities, East Garden Grove-Wintersburg (C05) Channel shows the ultimate design flow to be 400-cfs in the reach between Haster Basin and the Garden Grove Freeway. Description of Haster Basin on page 19 states "***The 5.5'H x 10'W RCB outlet is located at flowline elevation 103.9+/- and has a maximum discharge capacity of approximately 400-cfs below the spillway (650-cfs to top-of-levee)***". Alternatives 2, 3, 4, and 8 described in Tables 4.2, 4.4, 4.6 and 4.8, respectively, show an ultimate design discharge of 400-cfs upstream of the Garden Grove Freeway.

The Hydraulic Data Tables included on Sheet 15 of 16 of Exhibit No. 17, "Plan and Profile Sheets for Preferred Alternative (Alternative 8) Accompany this Report" show a design discharge of 400-cfs between the Garden Grove Freeway and Haster Basin.

B. Draft FEMA Flood Insurance Study (FIS) for the C05 Channel System, Prepared by West Consultants, Dated 1999

The study concluded that the Haster Retarding Basin has a negligible peak discharge reduction effect. The ineffectiveness of the Basin was attributed to the following:

- Deficient Influent Storm Drains
- Non-FEMA Certified Basin Levees

- Limited Basin Storage

C. Preliminary Design Report, Haster Retarding Basin, prepared by CH_2MHill, dated November 2001

The study evaluated multiple alternatives for improving the Haster Retarding Basin, and provided costs and preliminary design information for the preferred approach. Criterion for the recommended project was as follows:

1) Limit downstream channel discharges from the basin to a maximum of 450-cfs.

2) The 100-year expected value flow into the Basin is 2,200-cfs.

3) The 100-year storm is to be contained within the Basin with 2 feet of freeboard.

4) Two feet of dead storage is to be provided at the bottom of the basin for a water quality wetlands feature.

5) The maximum Basin water surface elevation is limited to 108.0 feet to ensure consistency with the City of Anaheim Drainage Master Plan hydraulic calculations for the Haster Street Relief Drain.

6) The Maximum water level should not exceed elevation 109.0 feet, to eliminate the need for levee certification.

The Preliminary Design Report recommended the construction of a 375-cfs pump station (3-125-cfs pumps) and regrading of the Basin to remove the existing island. The maximum water surface elevation would be limited to 108.0 feet, with the spillway elevation set at 110.0 feet. A 2-foot dead storage area (elevation 87.5-feet to elevation 89.5-feet) would be provided for a water quality wetlands area, and to maintain a water amenity at the Park.

Additionally, the report recommended improvements to the upstream East Garden Grove-Wintersburg Channel beyond those contained in the 1994 Project Report. These improvements were as follows:

1) Replace the reach of reinforced concrete box immediately upstream of Haster Basin (Reach 11A; Sta 596+81 - Sta 608+22) with a double 11.5-foot wide by 6-foot high reinforced concrete box (RCB). The 1994 Project Report had recommended constructing a second 9-foot by 6-foot RCB next to the existing 9-foot by 6-foot RCB storm drain.

2) Widen the 1994 Project Report recommended rectangular channel from 20 feet to 24 feet in Reaches 12A and 12C (Sta 608+22 - Sta 617+20 and Sta 617+83 - 622+17).

D. Hydrology Report, Haster Retarding Basin Facility No. C05B02 – Total Inflow Including Contributions from the East Garden Grove-Wintersburg Channel (C05) and Oertley Storm Drain (C05P19), Dated September 2001.

The report determined the expected value peak inflow to Haster Retarding Basin for return periods of 2, 5, 10, 25, 50 and 100 years. The calculated inflows were as follows:

Storm Frequency	Expected Value Peak Inflow
2-Year	540-cfs
5-Year	880-cfs
10-Year	1,400-cfs
25-Year	1,750-cfs
50-Year	2,000-cfs
100-Year	2,200-cfs

E. City of Anaheim Master Plan of Drainage for the South Central Area, Dated February 1993, Second Revision

The Master Plan provided a comprehensive long range planning tool for the City to implement drainage improvements in its South Central area. The report addressed areas tributary to the Anaheim-Barber City Channel and Haster Basin.

Improvements recommended for the Haster Basin systems included the construction of a 96-inch diameter storm drain in Haster Street that would discharge 420-cfs of flow directly into the Basin near the existing East Garden Grove-Wintersburg Channel inlet. When completed, the proposed facility would reduce the 100-year expected value flow in the undersized Oertley Storm Drain from 700 to 280-cfs.

1-3 SCOPE OF WORK

This study has been prepared to formulate a plan of action for the upgrade of the Haster Basin system to provide regional 100-year expected value flood protection. It will address Basin capacity, downstream channel capacity, operational requirements, facility layouts, costs, and construction issues. Specifically, the following will be evaluated.

1) Review the 2001 upstream hydrology studies prepared by CH_2MHill and the County of Orange to verify the results.

2) Analyze the channel capacity downstream of Haster Basin to verify the analysis contained in the 1994 Williamson and Schmid Study, and the 2001 CH_2MHill Report.

3) Prepare a hydrogeologic study to evaluate groundwater conditions underlying the Basin.

4) Analyze grading alternatives and prepare a hydraulic evaluation of Haster Basin. The Basin must be able to contain the 100-year expected value inflow of 2,200-cfs under the following conditions:

   - Basin water surface elevation cannot exceed 108-feet amsl to ensure compliance with upstream storm drain hydraulic calculations and to eliminate the need for levee certification by the Department of Dam Safety.
   - Downstream channel capacity cannot be exceeded.
   - Minimum Basin water surface elevation shall not be lower than the anticipated groundwater level.

5) Prepare a geotechnical study to supplement the previous work by the Orange County Materials Laboratory. The study will provide recommendations for the design and construction of the proposed pump station from a geotechnical perspective.

6) Develop concept pump station layouts and design recommendations consistent with project objectives and County of Orange requirements. At a minimum, the pump station is to include the following:

   - Pumps sized to deliver the maximum downstream channel capacity
   - Natural gas engines as pump drivers
   - LPG back-up fuel system
   - Inclined trash rack
   - Overhead crane for maintenance of the facility
   - Office with a restroom

7) Provide architectural treatment of the building which is appropriate for a park/public works type facility and which also complements the surrounding community.

8) Develop project costs estimates associated with implementation of the project. The cost estimates will be based upon vendor quotes, and current construction cost trends.

9) Identify construction issues which will impact the project. Maintenance of inflows during construction, dewatering, shoring, construction phasing, and construction monitoring will be addressed.

The report will focus upon developing the most viable alternative that will provide a level of service satisfying all project objectives. Options which improve upon the base level of operation will be identified as appropriate. These options may be added to the project, to produce a facility which exceeds the minimum standard, in areas that are deemed to be critically important.

1-4 REPORT LAYOUT

This report is presented in 11 sections with a separate Technical Appendix provided for calculations, reports, preliminary plans, and other supporting data that was utilized in the preparation of this study.

- *Section 1* is an overview of the entire project, defining the purpose and scope of this study.
- *Section 2* discusses the existing facilities and their level of service.
- *Section 3* analyzes the downstream channel capacity and recommends a maximum outflow from Haster Basin.
- *Section 4* summarizes hydrogeologic conditions present at the site, and identifies the underlying groundwater level. The full Hydrogeologic Report prepared by Ninyo and Moore is included in a separate Technical Appendix to this study.
- *Section 5* evaluates grading options and provides hydraulic calculations for the proposed Basin operation.
- *Section 6* is a summary of geotechnical recommendations developed for the structural design of the pump station. It also addresses the feasibility of the proposed grading, and analyzes the stability of the Basin slopes. The full Geotechnical Report prepared by Ninyo and Moore is included in a separate Technical Appendix to this study.
- *Section 7* provides concept layouts of the proposed pump station, which is consistent with facilities recently designed and constructed by the County. It lists recommendations for equipment to be furnished as part of the project and presents an architectural concept for the building.
- *Section 8* describes access roads, fencing, and utility services that will be included in the project. It also briefly addresses water quality and recreational improvements.
- *Section 9* discusses potential construction issues, delineates expected project phasing, and provides a schedule for completing the construction of the work.
- *Section 10* addresses costs associated with implementing the project.

1-5 ABBREVATIONS

To conserve space and improve readability, abbreviations have been used in this report. Each abbreviation has been spelled out in the text the first time it is used. Subsequent usage of the term is usually identified by its abbreviation. The list of abbreviations utilized in this report is provided in Table 1-1.

TABLE 1-1
ABBREVIATIONS

Abbreviations	Explanation	Abbreviations	Explanation
A	Amps	HGL	Hydraulic Grade Line
ac	Acres	HP	Horsepower
ACP	Asbestos Cement Pipe	LF	Lineal Feet
amsl	Above Mean Sea Level	LPG	Liquefied Petroleum Gas
Basin	Haster Basin	LS	Lump Sum
BAT	Best Available Technology	MEP	Maximum Extent Practicable
BEP	Best Efficiency Point	MG	Million Gallons
BMP	Best Management Practices	MGD	Million Gallons per Day
BMEP	Brake Mean Effective Pressure	MCC	Motor Control Center
CWA	Clean Water Act	NEC	National Electric Code
cfm	Cubic Feet per Minute	NFPA	National Fire Prevention Association
cfs	Cubic Feet per Second	NPDES	National Pollutants Discharge Elimination System
cy	Cubic Yards	NPSH	Net Positive Suction Head
C05	East Garden Grove-Winterburg Channel	OCSD	Orange County Sanitation District
C05P19	Oertly Storm Drain	OCWD	Orange County Water District
CIP	Cast Iron Pipe	O&M	Operations and Maintenance
CMP	Corrugated Metal Pipe	OSHA	Occupational Safety & Health Administration
cy	Cubic Yard	PVC	Polyvinyl Chloride
DAMP	Drainage Area Management Plan	PTO	Power Take Off
DIP	Ductile Iron Pipe	PDR	Preliminary Design Report
ea	Each	RWQCB	Regional Water Quality Control Board
ENR	Engineering News Records	RCB	Reinforced Concrete Box
ev	Expected Value	RCC	Reinforced Concrete Channel
FEMA	Federal Emergency Management Agency	RCP	Reinforced Concrete Pipe
fpm	Feet per Minute	STC	Sound Transmission Class
fps	Feet per Second	SF	Square Feet
FRP	Fiberglass Reinforced Plastic	SES	Stored Energy System
FIS	Flood Insurance Study	SCADA	Supervisory Control and Data Acquisition
FLA	Full Load Amps	V	Volts
gpd	Gallons per Day	VCP	Vitrified Clay Pipe
gpm	Gallons per Minute	VFD	Variable Frequency Drive
		WQMP	Water Quality Management Plan

Section 2
EXISTING FACILITIES

2-1 INTRODUCTION

Haster Retarding Basin/Twin Lakes Park is located at the intersection of Haster Street and Lampson Avenue in the City of Garden Grove. The Basin serves an 1,845-acre drainage area, which extends north to Vermont Avenue in the City of Anaheim; east to State College Boulevard in the Cities of Orange and Anaheim; and west to Harbor Boulevard in the Cities of Anaheim and Garden Grove. The Santa Ana Freeway (Interstate 5) bisects the area. Land use west of Interstate 5 is primarily residential homes. Land use east of the freeway is predominately industrial/commercial development. The Haster Basin drainage area is shown on Figure 2-1.

Stormwater and dry weather run-off are conveyed to the Basin by the Oertley Storm Drain (C05P19) and the East Garden Grove- Wintersburg Channel (C05).

The Oertley Storm Drain is a 96-inch RCP, which enters the Basin from the north, near the middle of the lower lake, at an invert elevation of 96.17 feet. Design capacity for the Oertley Storm Drain is 400 cfs. The 100-year expected value flow tributary to this facility is 700 cfs. The Haster Street Relief Storm drain is a future City of Anaheim project which will discharge to the Basin near the existing C05 inlet. The facility is a 96-inch RCP designed to relieve 420 cfs from the Oertley system.

The East Garden Grove-Wintersburg Channel discharges into the northeast corner of the Basin, near the intersection of Lampson Avenue and Haster Street. The facility is a 9-foot by 6-foot reinforced concrete box with an invert elevation of 96.11 feet at its outlet into the upper lake. Design capacity for the East Garden Grove-Wintersburg Channel is 650-cfs. The 100-year expected value flow tributary to this facility is 1,573-cfs.

Also contributing flow to the Basin is a City of Garden Grove 4,000-gpm (8.9-cfs) domestic water well, located on Haster Street, in the upper lake area of the park. The well discharges approximately 1,500-gpm (3.3-cfs) to the Basin during its waste cycle. The waste cycle is ten (10) minutes in duration, and occurs each time the well is started. The City reports that the well is not operated during the winter season. A picture of the well facility is shown in Photograph 2-9.

The downstream conveyance facility (East Garden Grove-Wintersburg Channel) is a 10-foot wide reinforced concrete channel with an original design flow of 360-cfs. Invert elevation of the channel at the Basin outlet is 103.31 feet. The capacity is controlled by the existing 10-foot by 4-foot RCB at Aspenwood Lane, just south of the Basin.

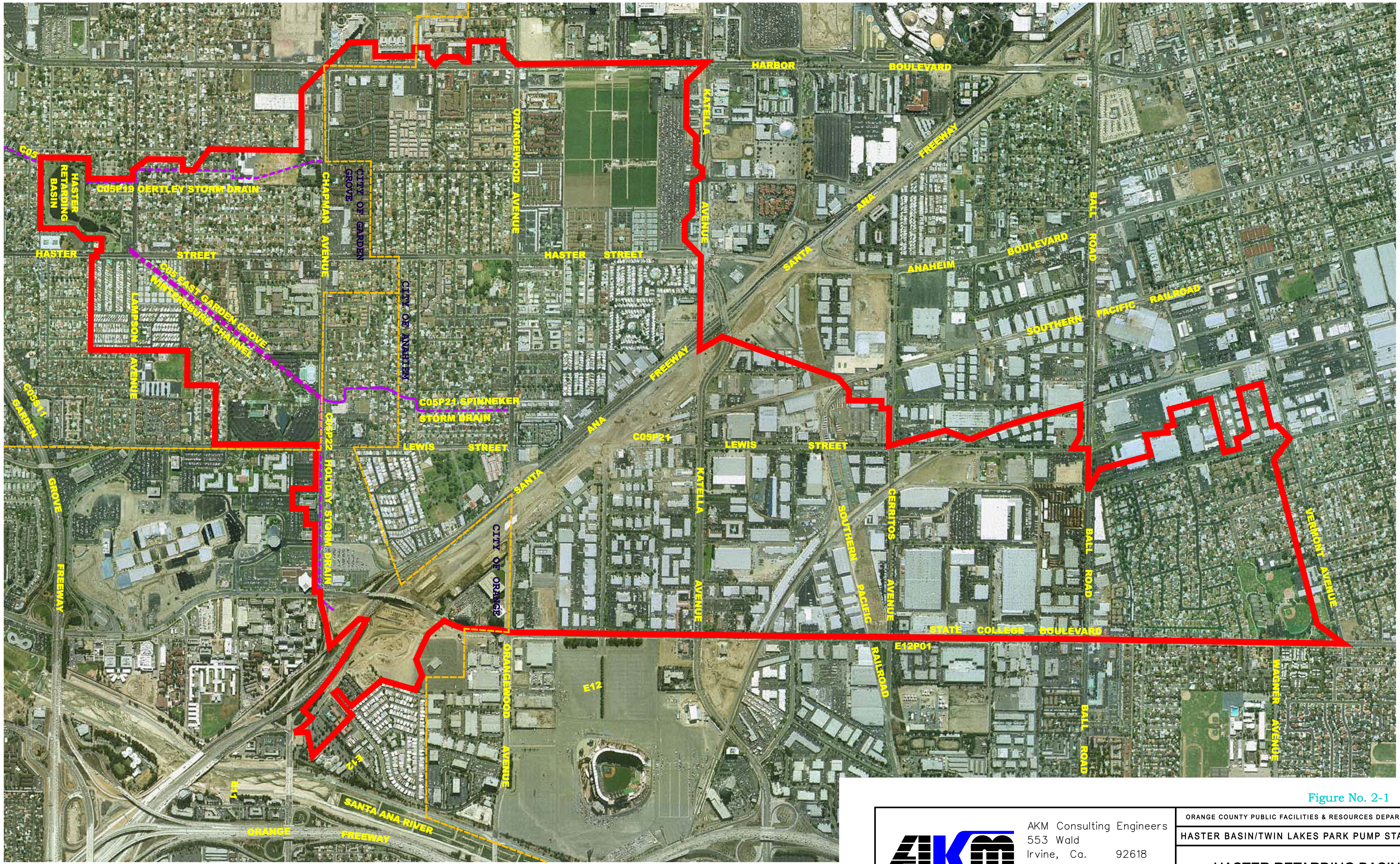

Figure No. 2-1

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ORANGE COUNTY PUBLIC FACILITIES & RESOURCES DEPARTMENT

HASTER BASIN/TWIN LAKES PARK PUMP STATION

HASTER RETARDING BASIN DRAINAGE BOUNDARY

$FILE$ 3/30/2010

The site is also a City-operated public park. Park facilities include: a children's play area, picnic tables, a walking and jogging path, extensive landscaping and irrigation systems, various lake water supply and water quality systems, and a parking lot.

This section of the PDR will discuss current Basin operations and will provide information on the various facilities located at the site.

2-2 EXISTING SITE AND COUNTY PROPERTY

An aerial view of Haster Basin is shown on Figure 2-2. Single family residential homes surround the site to the north, west, and south. Land use along the east property line includes a convalescent hospital and City-owned domestic water well. A mixture of wood fences, block walls, and a chain-link fence surround the Basin perimeter. Much of the chain-link fence is in poor condition and is in need of replacement.

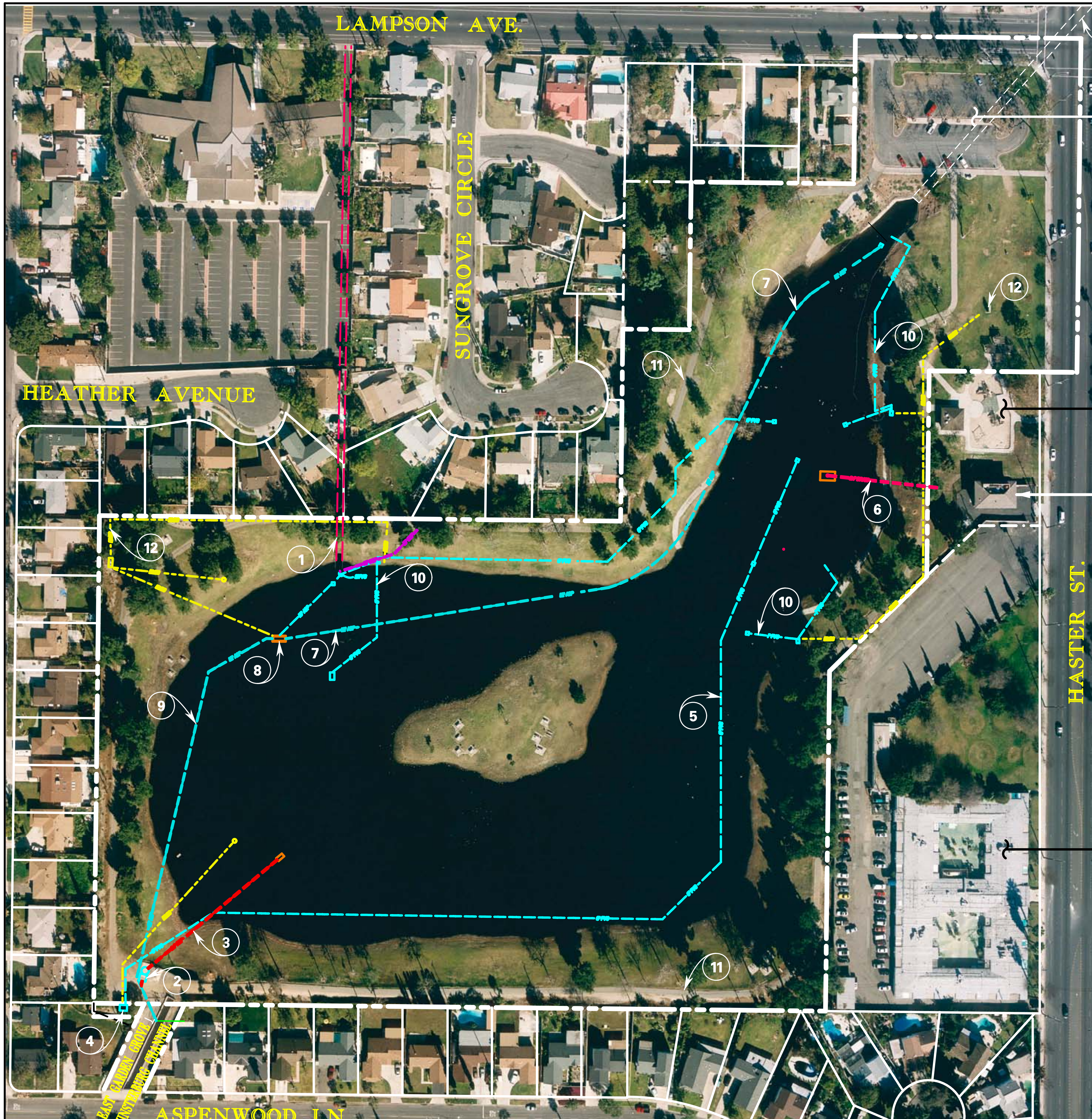
Contiguous with the County property are areas owned by the City of Garden Grove which are used as part of Twin Lakes Park. These areas are as follows:

- 0.4 acre parcel located in the north west corner of the site. The area includes picnic table facilities for park users.
- 0.8 acre parcel located between the east County property line and Haster Street. A children's play area, and City of Garden Grove domestic water well are situated on this property.
- 1700-SF parcel located in the southwest corner of the site, in an area notched out of the homeowner's lot at 12731 Aspenwood Lane. An abandoned City-owned well, which was used at one time to fill the lake and irrigate the park, is installed on this land.

A boundary survey map of the County property line at Haster Basin, prepared by the County Geometrics/LIS Division, is provided on Figure 2-3.

Pictures of the Haster Retarding Basin/Twin Lakes Park are shown in Photographs 2-1 through 2-3. The location was originally a sand and gravel quarry, prior to being acquired by the County of Orange for use as a Retarding Basin. In 1972, the County entered into a 25-year agreement with the City of Garden Grove, allowing the City to use the site as a Park (Twin Lakes Park). As part of this agreement, the City assumed primary responsibility for operation and maintenance of the Basin.

The park has become an important asset to the City of Garden Grove as it is one of only a few recreational areas located in the eastern section of the City. It offers a tranquil setting for picnicking, jogging, and bicycling, and is heavily used year-round.



LEGEND

- PROPERTY LINES
- COUNTY PROPERTY
- CITY PROPERTY
- EXISTING 96" SD
- EXISTING WATER
- EXISTING 12" ACP WATER
- EXISTING ELECTRICAL
- EXISTING 24" DRAIN
- EXISTING 18" CMP SD
- EXISTING 24" CRP SD

1. 96-INCH RCP OERTLEY STORM DRAIN
2. 2500 GPM LAKE SUBMERSIBLE PUMP STATION
3. 24-INCH PUMP STATION INTAKE
4. 200-FT, LAKE FILL / RECIRCULATION WELL (ABANDONED)
5. 6-INCH LAKE FILL / RECIRCULATION PIPE (ABANDONED)
6. 24-INCH CITY OF GARDEN GROVE DOMESTIC WELL, PUMP TO WASTE DISCHARGE PIPE.
7. 12-INCH, LOW FLOW DIVERSION PIPE (ABANDONED)
8. LOW FLOW DIVERSION PUMP STATION (ABANDONED)
9. LOW FLOW DIVERSION DISCHARGE PIPE (ABANDONED)
10. IRRIGATION PUMP INTAKE PIPE
11. 8' WIDE BASIN PERIMETER ROAD
12. LOW FLOW DIVERSION / IRRIGATION SYSTEM ELECTRICAL SERVICE

Figure No. 2-2

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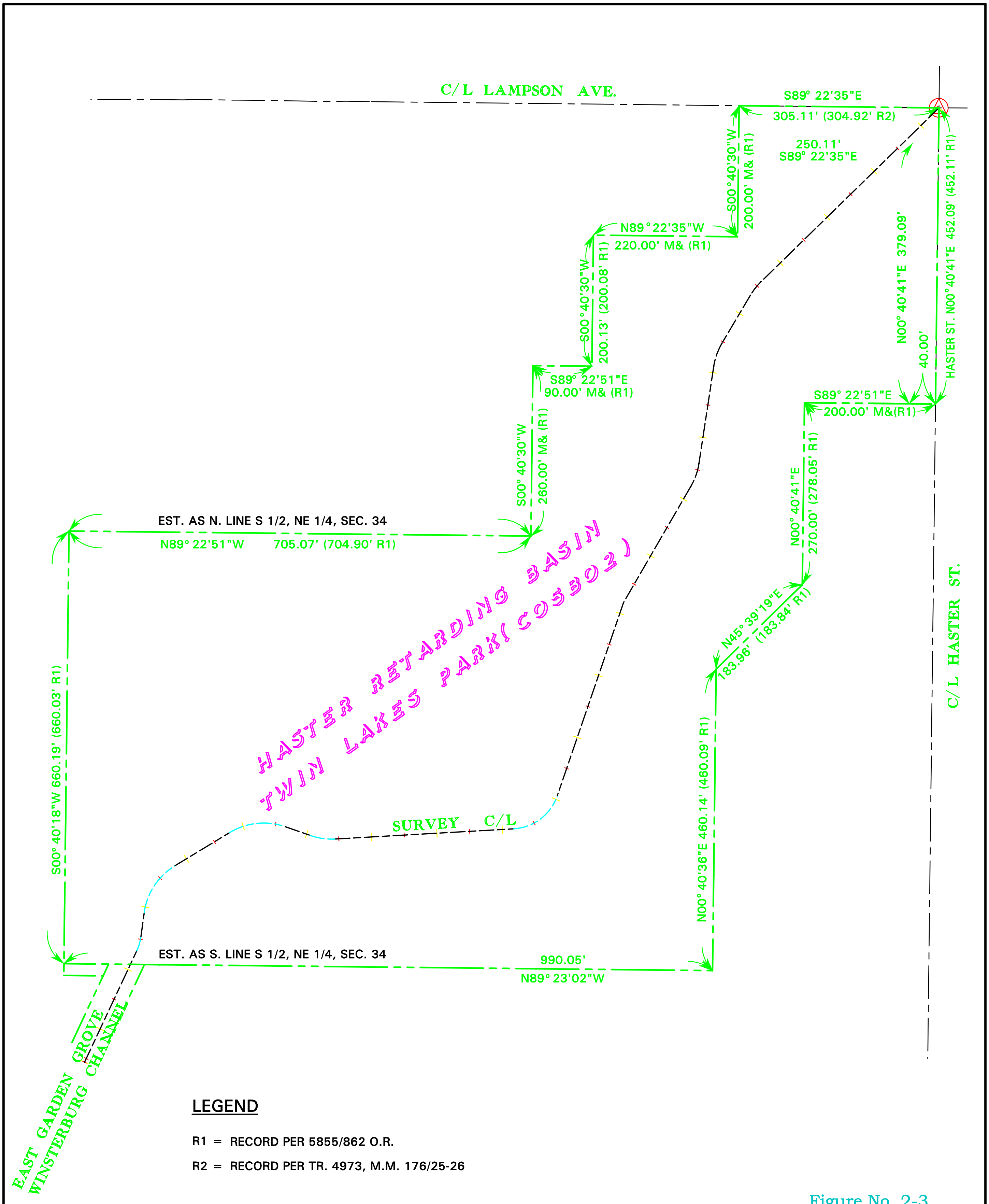
HASTER BASIN/TWIN LAKES PARK PUMP STATION

HASTER BASIN
AERIAL PHOTOGRAPH

$FILE$ 3/30/2010



LEGEND

R1 = RECORD PER 5855/862 O.R.

R2 = RECORD PER TR. 4973, M.M. 176/25-26

Figure No. 2-3

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

HASTER BASIN PROPERTY SURVEY

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PHOTO 2-1. View Looking North Along Park Westerly Perimeter

PHOTO 2-2. View Looking East from Northwest Perimeter of the Lake

PHOTO 2-3. Northeast Corner of Twin Lakes Park at the C05 Inlet

In 1997, the agreement between the City and County expired. Despite attempts to negotiate a new agreement, mutually acceptable terms could not be reached. Currently, the County has assumed responsibility for operation of the lake. Maintenance of the surrounding Park facilities and landscaping is still being performed by the City of Garden Grove.

The Basin itself consists of an upper and lower lake, preceded by a desilting Basin at the outlet of each influent storm drain (see Figure 2-4). Calculations prepared by CH_2MHill in their 2001 study showed the Basin provides storage capacity approximately equivalent to a 5-year storm without overtopping its spillway (elevation 110.0-ft).

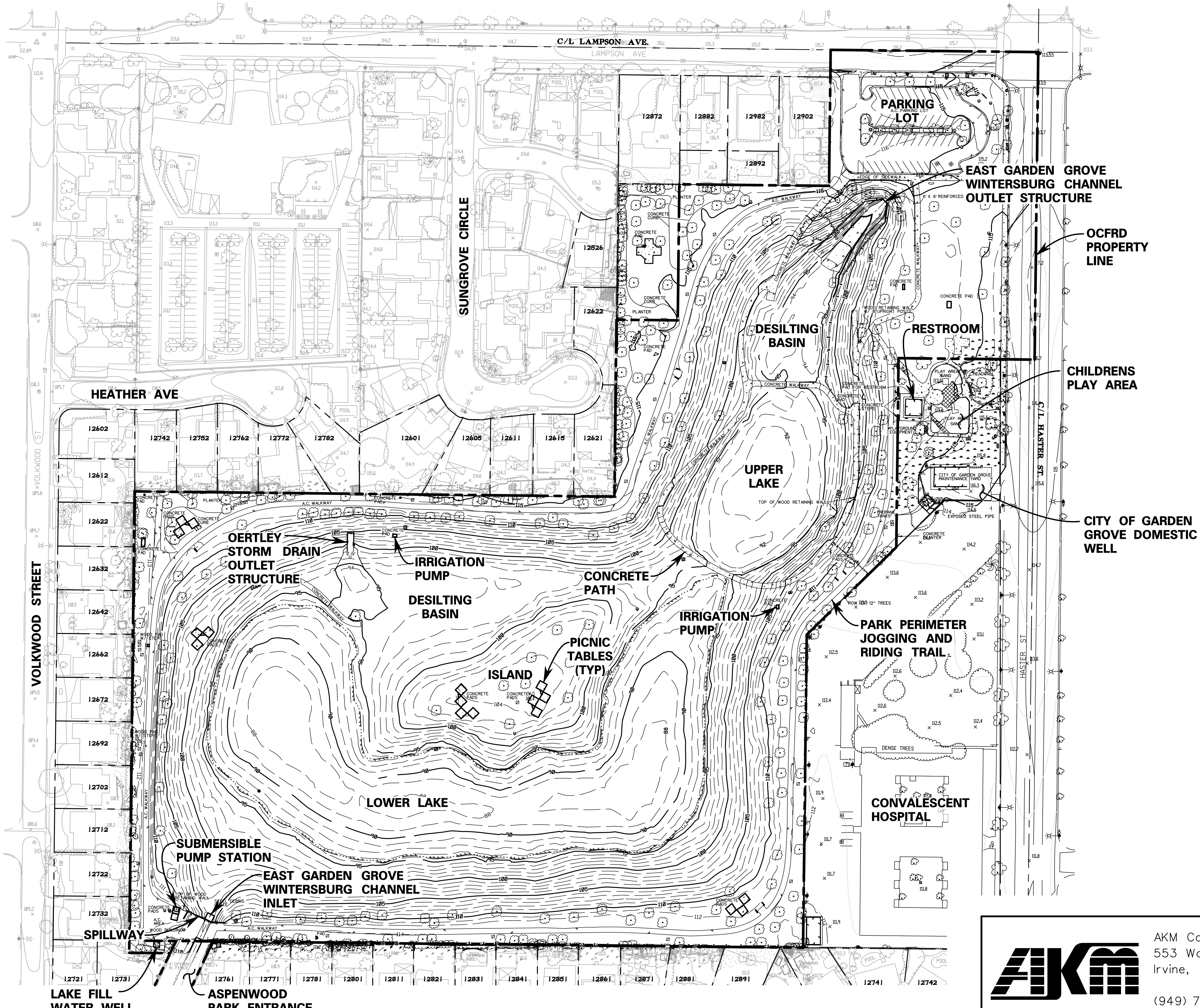

Figure No. 2-4

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

EXISTING HASTER BASIN TOPOGRAPHIC MAP

$FILE$ 3/30/2010

Haster Basin's capacity, in relation to storm frequency, as reported in the CH_2MHill study is presented in Table 2-1. The Retarding Basin has overflowed only once in its history during the heavy rains of 1983.

TABLE 2 -1
HASTER BASIN EXISTING CAPACITY

Storm Frequency	Peak Inflow (cfs)	Peak Outflow (cfs)	Max. Water Surface Elevation (ft)
2	545	310	102.22
5	890	480	109.27
10	1,385	610	111.30*

**Spillway elevation is 110.0-feet.*

2-3 EXISTING PARK AND BASIN FACILITIES

Through the years, the City and County have constructed a number of amenities and facilities to improve the overall appeal and operation of the Park and Basin. These facilities are described below, and shown in photographs located throughout this section.

Landscaping and Irrigation Systems

The City has installed extensive landscaping and irrigation systems throughout the County-owned and City-owned areas of the site. The landscaping currently consists of grasses, some shrubs, and large mature trees of various species (alder, peppermint, sycamore, pine and willow). There are approximately 301 trees located throughout the site in both County and City-owned areas.

The landscaping system consists primarily of PVC piping in sizes ranging from ¾-inch to 4-inch, sprinkler heads, control valves, and pumps. As originally designed, water from the lake was used to supply the sprinkler system. Later, a well pump located in the southwest corner of the site was used for this purpose. Maximum irrigation water demand is estimated as 200-gpm (0.45-cfs) at 80-psi. As designed, the irrigation systems installed in County and City-owned areas of the Park are completely interconnected. A picture of a typical irrigation pump is shown in Photograph 2-4.

PHOTO 2-4. Irrigation Pump

Recreational Amenities

The City also constructed recreational improvements throughout the Park. These consist of:

- 23 picnic tables and benches
- Exercise stations located at various spots along the perimeter of the Basin
- A walking and jogging trail, consisting of an 8-foot wide, 2½-inch thick AC path extending around the park perimeter
- Concrete walking paths – Concrete walking paths were constructed in areas of the Park that are periodically submerged during rainy periods.
- Children's play area - Located on City-owned property, the equipment includes play sets, a covered picnic facility, play sand and turf areas.
- A park restroom located adjacent to the children's play area.

Pictures of the miscellaneous recreational facilities are shown in Photographs 2-5 through 2-10.

PHOTO 2-5. Children's Play Area

PHOTO 2-6. Park Restroom

PHOTO 2-7. Covered Picnic Structure

PHOTO 2-8. Exercise Station

PHOTO 2-9. City of Garden Grove Domestic Water Well

PHOTO 2-10. Isthmus between Upper & Lower Lake – Dry Weather Runoff Diversion Manhole Can Be Seen In Foreground

Lake Fill Water Well

A 200-foot water well was constructed in the southwest corner of the Basin. The well was used to fill the lake, augmenting run-off collected in the Basin. It was also used to supply the sprinkler systems at the site. The City reports that the water provided by the well has high nitrate levels, and is currently not operated. The lake fill water well is shown in Photograph 2-11.

PHOTO 2-11. Lakefill Well (Abandoned)

Low Flow Diversion

A low flow diversion system was constructed to intercept dry weather flows from the East Garden Grove-Wintersburg Channel (C05) and discharge them downstream. The system consisted of a grated sump box located near the outlet of C05, and 6-inch piping to a submersible pumping station constructed near the outlet of the Oertley Storm Drain. The system was difficult to maintain, and the piping and sump box were ineffective in conveying flow to the pump station. As a result, the system was not extensively used, and has been abandoned (refer to Figure 2-2).

Stormwater Pump Station

A submersible pump station was constructed to control lake levels during storm events. The facility is located in the southwest corner of the Basin near the spillway. The system consists of a 10-foot diameter wet well, two (2) 2,500-gpm (5.6-cfs) sliderail submersible pumps, valve vault, grated inlet and piping, and discharge piping to the channel. The pump station can operate automatically, but is currently being operated in manual mode by the County. Figure 2-5 shows the existing pump station.

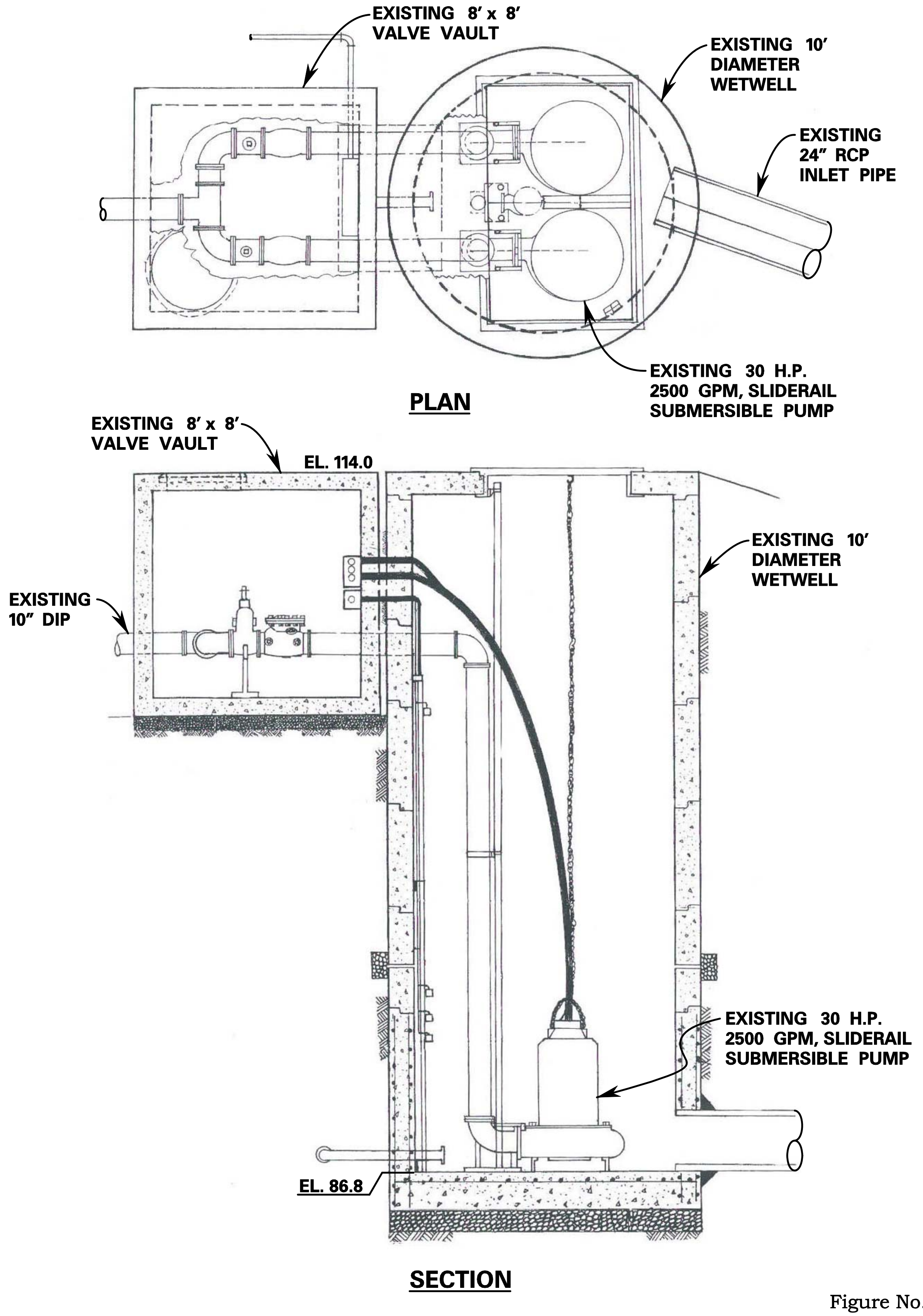

Figure No. 2-5

AKM Consulting Engineers 553 Wald Irvine, Ca. 92618 (949) 753-7333	ORANGE COUNTY PUBLIC FACILITIES & RESOURCES DEPARTMENT HASTER BASIN/TWIN LAKES PARK PUMP STATION EXISTING LOWER LAKE PUMP STATION

$FILE$ 3/30/2010

Lake Recirculation System

To improve water quality, a recirculation system was installed to transfer water from the southwest corner of the Basin (near the outlet), to the northeast corner of the Basin (near the inlet). A third, smaller pump was installed in the submersible pump station to move the water. The lakefill pipeline was used to convey the water to the upper lake, with valving provided to isolate the well or the discharge pipe to the channel, depending upon the system in use. The City has reported that the recirculation system has never been placed into operation (refer to Figure 2-2).

Park Access and Parking

The Park may be accessed through a parking lot located at the corner of Haster Street and Lampson Avenue, or through an entrance in the southwest corner of the Basin from Aspenwood Lane.

The parking lot is a paved facility which has been landscaped, and incorporates signage identifying the park. Access to the lot is from Lampson Avenue only. There are 42 regular parking spaces and 2 handicapped parking spaces available.

The entrance from Aspenwood Lane consists of a 15-foot wide paved path, which is located on the east side of the East Garden Grove-Wintersburg Channel Outlet. Access to this walkway is through a 4-foot wide chain like gate. There is also vehicular access available from Aspenwood Street on the west side of the channel. This is a 25-foot wide paved area that is secured by a 20-foot chain link gate. This entrance is normally locked and is for County or City-owned vehicles only.

Berm Modifications

In 1985, the County raised the berm along the north, south and east perimeter of the Basin to approximately elevation 114.0 feet (a 1.5-foot to 2.5-foot increase in height). The project provided additional protection to the homes surrounding the site (pad elevations 110 feet to 112 feet), which were flooded during the 1983 storm event. This berm is also the paved walking/jogging path which encircles the Basin. A photo of the berm is shown in Photograph 2-12.

PHOTO 2-12. Berm

Basin Liner

Staff members from the City of Garden Grove have indicated that a Visqueen liner was installed in the Basin to create a year-round lake feature. Soil borings conducted by the County's Materials Lab, and Ninyo and Moore found no presence of such a liner. It is therefore concluded that no liner exists, and the year-round lake is simply the result of high groundwater levels in the area.

2-4 INFLUENT STORM DRAINS

Flow is conveyed to Haster Basin via the East Garden Grove-Wintersburg Channel and the Oertley Storm Drain. Each of these facilities is described below. Pictures of the existing outlet structures are shown in Photographs 2-13 and 2-14.

PHOTO 2-13. Oertley Storm Drain Outlet

PHOTO 2-14. East Garden Grove-Wintersburg Channel Outlet

- *East Garden Grove-Wintersburg Channel*

  The East Garden Grove-Wintersburg Channel (C05) was constructed in 1964. It is a reinforced concrete box and concrete trapezoidal channel that extends from Haster Basin to Chapman Avenue, where it terminates at the outlet of the Holiday Storm Drain (C05P22) and the Spinnaker Storm Drain (C05P21), see Figure 2-6.

  Total area tributary to C05 is 1,195 acres. The 100-year expected value flow to this facility is 1,573-cfs. Its invert elevation at Haster Basin is 96.11-feet. Although originally designed to convey a 25-year storm event, changing hydrogeologic criteria, have resulted in the storm drain having less than a 10-year capacity (existing design capacity 650-cfs).

- *Oertley Storm Drain*

  The Oertley Storm Drain (C05P19) was constructed in 1968. It is a 96-inch RCP that enters Haster Basin at an invert elevation of 96.17-feet. Its alignment is located north between Heather Avenue, Sungrove Circle, and Oertley Drive, terminating in Chapman Avenue at Somerset Place, where it joins a City of Anaheim storm drain (see Figure 2-6). Area tributary to the Oertley system is 625 acres of primarily residential land use. Design capacity of the facility is 400-cfs. The 100-year expected value flow rate into this system is 700-cfs.

  The City of Anaheim, in its Master Plan, has proposed the construction of the Haster Street Relief Drain, which will pick up flows from areas along Haster Street (420 cfs) and outlet them directly to Haster Basin. Once complete, the 100-year expected value flow in the Oertley Drain will be reduced from 700 cfs to 280 cfs.

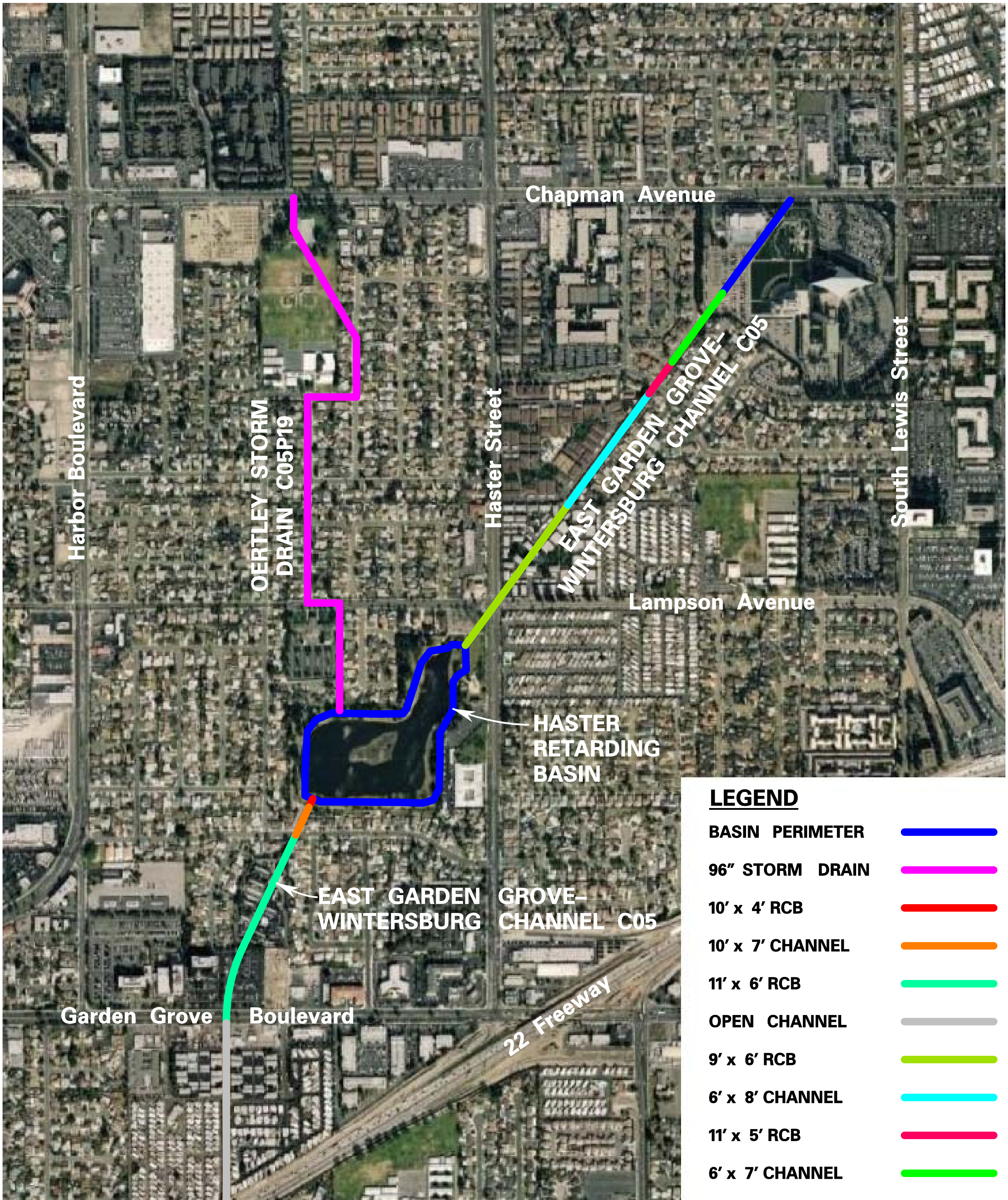

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EXHIBIT No. 2-6

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

HASTER BASIN
INLET AND OUTLET FACILITIES

$FILE$ 3/30/2010

2-5 DOWNSTREAM DRAINAGE CONVEYANCE SYSTEM

Water flowing out of Haster Basin is conveyed by the East Garden Grove-Wintersburg Channel. This facility is a 30-foot long, 10-foot by 5.5-foot RCB at the Basin outlet which transitions to a 10-foot wide reinforced concrete rectangular channel. The invert elevations of the RCB at the Basin outlet, and at its downstream end are 103.92 feet and 103.84 feet, respectively.

The rectangular channel extends approximately 135 feet southerly to Aspenwood Lane with a grade line slope of 0.00378. The top of the rectangular channel walls extend anywhere between 2 inches and 30 inches above the surrounding pavement, and are about 8 feet above the channel invert. There are two 18-inch high by 18-inch wide openings in the wall at the pavement grade to collect surface drainage. An iron grate (4-inch bar spacing) is located over the inlet to the RCB (outlet of the Basin) to block large pieces of debris from flowing downstream.

The Aspenwood Lane crossing is a 70.34-foot long 10-foot wide by 4-foot high RCB at a slope of 0.00384. It is this location which controls the maximum outflow from the Basin. This flow is identified as between 400 cfs and 450 cfs in the 1994 Project Report.

Photograph 2-15 shows the 10-foot wide rectangular channel and the 10-foot wide by 4-foot high box culvert at Aspenwood Lane. Photograph 2-16 shows the grated Basin outlet.

PHOTO 2-15. Downstream East Garden Grove-Wintersburg Channel

PHOTO 2-16. East Garden Grove-Wintersburg Channel Inlet Structure and Trash Grate

Downstream of Aspenwood Lane, there is a 15-foot long transition to an 11-foot wide by 6-foot high RCB. This transition and 751.44 feet of 11-foot wide by 6-foot high RCP were constructed in 1978 and replaced the original reinforced concrete trapezoidal channel. During this construction, the grade line of the channel was lowered by 6 inches at the beginning of the transition section, which resulted in reducing the slope from 0.0022 to 0.0015. The 11-foot wide by 6-foot high RCB continues to the north side of Garden Grove Boulevard at a slope of 0.0022 It then transitions in 30 feet (transition slope of 0.0180) to a 10-foot wide by 5.5-foot high RCB, which extends 102.28 feet southerly at a slope of 0.0033 through Garden Grove Boulevard. The channel transitions in 30 feet to a reinforced concrete trapezoidal channel with a base with of 6 feet, and side slopes of 1.5:1.

The trapezoidal channel extends 1085.69 feet southerly to the north side of Garden Grove Freeway at a slope of 0.00248.

The crossing of the Garden Grove Freeway was recently modified to accommodate the expected value 100-year runoff. The project included one 84-inch RCP on each side of the existing 12-foot wide by 6-foot high RCB, and transition to the existing trapezoidal section on the downstream side. On the north side (upstream) of the freeway, the modification consisted of a transition from the existing trapezoidal section to a double 10-foot wide by 10-foot high RCB, then to the headwall of the freeway crossing, where the new Lewis Storm Channel confluences with C05.

Between Garden Grove Freeway and Harbor Boulevard, C05 is a reinforced concrete trapezoidal channel with a base width of 6 feet and side slopes of 1.5:1. The grade line slopes are 0.0103 and 0.00235 between the Garden Grove Freeway and Pearce Street; 0.00285 between Pearce Street and Trask Avenue; and 0.00232 to 0.00230 between Trask Avenue and Harbor Boulevard. The crossings of the Garden Grove Freeway, Pearce Street, Trask Avenue, and Harbor Boulevard are 12-foot wide by 6-foot high RCB, 12-foot wide by 5-foot high RCB, 12-foot wide by 6.5-foot RCB, and 12-foot wide by 6.5-foot wide RCB, respectively.

Downstream of Harbor Boulevard, it is generally an open trapezoidal channel of varying base widths, side slopes, and materials to its outlet into the Bolsa Chica Ecological Reserve, located just south of Warner Avenue. The East Garden Grove-Wintersburg Channel alignment is shown on Figure 2-7.

2-6 BASIN OPERATION

The Basin had been operated by the City in the past to maintain the water surface elevation between 94.5-feet and 95-feet (approximately 7 to 8 feet of water). Generally, the Basin was operated by the City in the following manner:

- The stormwater submersible pump station was started when the Basin level reached 95.0-feet.
- The stormwater pump station was stopped when the Basin level was reduced to elevation 94.5 feet.
- If the Basin level continued to rise above elevation of the outlet channel (103.31-feet) the pump station was stopped, and the Basin outflow continued by gravity.

After the expiration of the Park agreement, the County assumed responsibility over control of the Basin's water level. Because of the poor water quality normally found in the Basin, the small pump station is generally not operated. Now the normal water surface elevation of the Basin is about 100-ft. All dry weather flow is captured and is lost either through evaporation or infiltration. This higher normal water surface elevation also provides a wet weather water quality benefit in that there is a larger pool of "treated water" available to dilute the incoming storm water before it is discharged downstream.

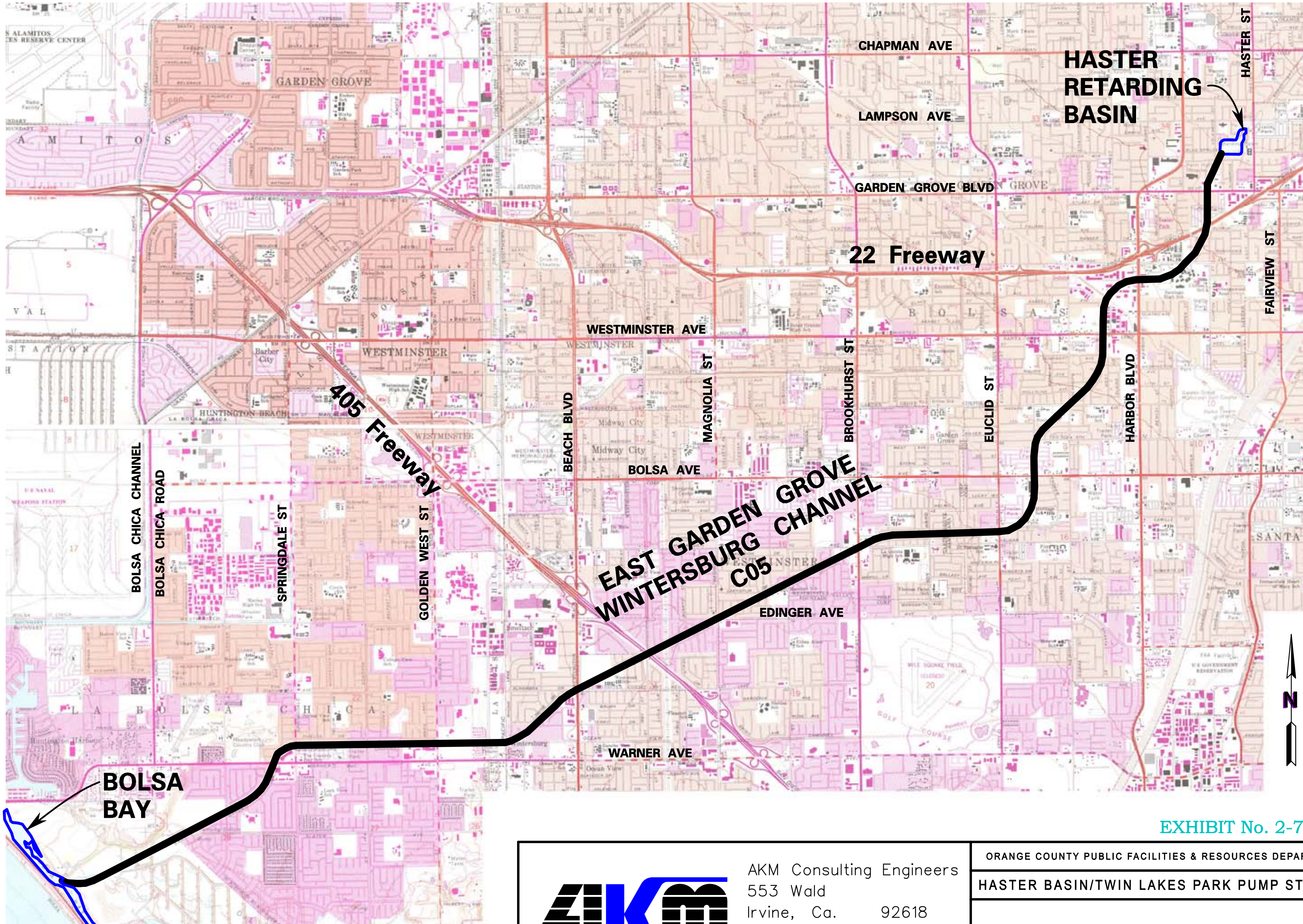

EXHIBIT No. 2-7

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

HASTER BASIN OUTLET

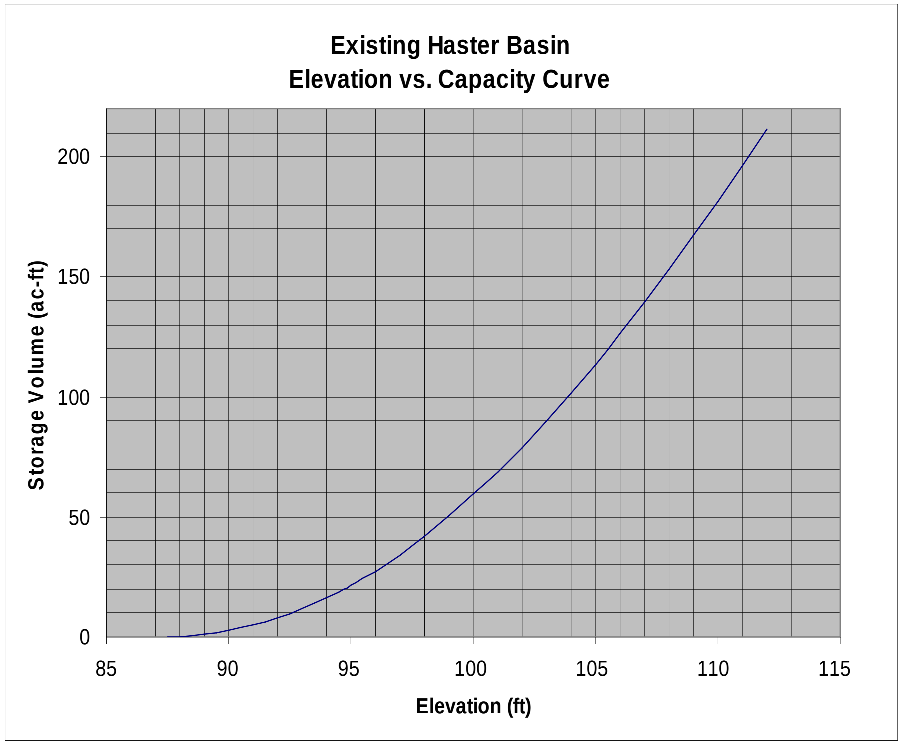
$FILE$ 3/30/2010

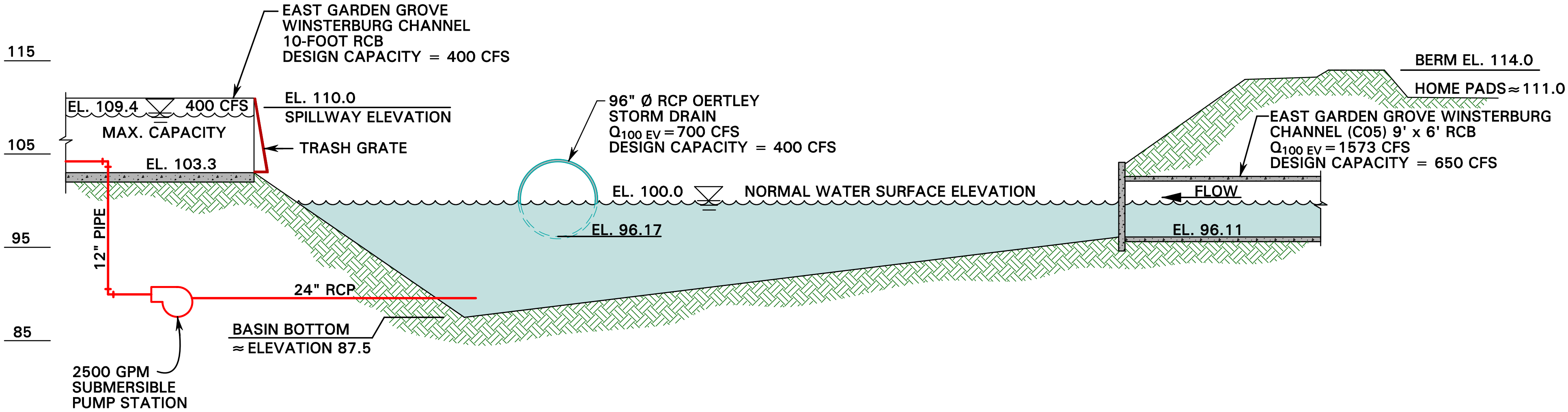
The water quality benefits, which have been generated by not operating the pump station, have reduced the level of flood protection which would have been available. Approximately 40 ac-ft of storage volume has been lost by maintaining the higher Basin water level.

An elevation-capacity curve for the existing Basin conditions is shown on Figure 2-8 (existing Basin capacity to the spillway is 181 ac-ft.) A graphical depiction of the Basin operation is shown on Figure 2-9.

FIGURE 2-8. Existing Haster Basin Capacity

Elevation	Area	Volume	
(ft)	(ft^2)	(ft^3)	(ac-ft)
87.5	0	0	0
88	26846.5	4474.4167	0.103
88.5	44962.9	22233.199	0.51
89	63079.3	49116.274	1.128
89.5	75153	83630.325	1.92
90	87226.7	124187.79	2.851
90.5	99149.5	170750.03	3.92
91	111072.3	223277.28	5.126
91.5	127871.5	282963.96	6.496
92	144670.7	351056.32	8.059
92.5	162993.2	427926.79	9.824
93	181315.7	513963.36	11.799
93.5	197290.15	608586.73	13.971
94	213264.6	711199.51	16.327
94.5	226620.85	821153.97	18.851
95	239977.1	937787.52	21.529
96	277052.6	1196080.5	27.458
97	318120.5	1493430.7	34.284
98	348905.9	1826825.4	41.938
99	377364.4	2189867.6	50.272
100	405178.9	2581056.8	59.253
101	432189.4	2999668.3	68.863
102	458759	3445076.5	79.088
103	485822	3917302.4	89.929
104	516545.7	4418407.7	101.433
105	543428.1	4948337.8	113.598
106	562912.9	5501479.7	126.297
107	581568.5	6073695.1	139.433
108	600108.1	6664509.1	152.996
109	619104.8	7274090.9	166.99
110	638990.2	7903112.2	181.43
111	659662.2	8552411	196.336
112	685603.8	9225002.3	211.777





BASIN OPERATION

Figure No. 2-9

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

BASIN OPERATION

$FILE$ 3/30/2010

Section 3
DOWNSTREAM CHANNEL CAPACITY

3-1 BASIN INFLOW HYDROGRAPH

The updated hydrology study for the Haster Retarding Basin was completed by the Orange County Public Works (OCPW). This study is presented in "Hydrology Report, Haster Retarding Basin, Facility No. C05B02, Total Inflow Including Contributions from East Garden Grove-Wintersburg Channel (C05) & Oertley Storm Drain (CO5P19)," Dated September 2001.

The Hydrology Report provides the expected value peak inflow to the Haster Basin for 2, 5, 10, 25, 50, and 100 year storm events, including a multi-day 100-year expected value runoff. It utilized the AES Rational Method Hydrology, and Flood Routing Analysis programs with a single area hydrograph. The results of the expected value 100-year, multi-day storm are summarized in Table 3-1.

TABLE 3-1
OCPFRD PROJECT REPORT HYDROLOGY RESULTS
(100-Year Multi-Day Storm)

	1-Day	2-Day	3-Day
Peak Runoff	279.95-cfs	808.47-cfs	2192.33-cfs
Runoff Volume	83.9 ac-ft	219.6 ac-ft	553.9 ac-ft

AKM Consulting Engineers (AKM) utilized the input data from the Hydrology Report with the LAPRE and HEC-1 programs to develop the inflow hydrograph to Haster Retarding Basin. The results of the AKM studies are listed in Table 3-2.

TABLE 3-2
AKM HASTER BASIN HYDROLOGY STUDY RESULTS
(100-Year Multi-Day Storm)

	1-Day	2-Day	3-Day
Peak Runoff	276-cfs	791-cfs	2193-cfs
Runoff Volume	84 ac-ft	220-ac-ft	554-ac-ft

As the AKM study results closely replicate those contained in the County's Hydrology Report, it is considered to be an accurate representation of the Haster System and suitable for use in analyzing the various basin alternatives.

3-2 EXISTING CHANNEL CAPACITY

The East Garden Grove-Wintersburg Channel (CO5) was constructed in 1961 with a 25-year design outflow rate of 360-cfs from Haster Basin. Between the basin outlet and Harbor Boulevard, it has three major tributaries. One is Lewis Storm Channel (C05S11), a 12-foot wide by 8-foot high RCB along the north side of Garden Grove Freeway, which confluences with C05 just north of the Garden Grove Freeway crossing. The original design flow from Lewis Channel is 250-cfs (Total C05 design flow of 610-cfs). The second and third tributaries that confluence with C05 are located at Trask Avenue. One is a 78-inch diameter local storm drain from the west, and the other is a 60-inch diameter local storm drain from the east. The original combined design flow from these two storm drains was 160-cfs, resulting in a C05 design flow of 770-cfs.

The hydrologic studies conducted for the Project Report for East-Garden Grove Wintersburg (C05) and Oceanview (C06) Channels utilized a maximum Basin outflow of 400-cfs for the ultimate conditions. The hydraulic data table included on Sheet 15 of 16 of the Plan and Profile Sheets (Exhibit No. 17) of the Project Report indicates a maximum basin outflow of 400 cfs, and 990 cfs at the confluence of Lewis Channel.

The maximum outflow from the basin impacts the storage volume needed in the basin. Because the improvements recommended by the Project Report will take years to complete, the downstream channel may not have the capacity to convey the design flows developed by the Project Report in accordance with the flood protection criteria until all the improvements are completed. Therefore, the C05 Channel downstream of Haster Basin was analyzed with various basin outflows for both the existing channel conditions, and the ultimate channel conditions.

The WSPG program was utilized to analyze the channel capacity from 494 feet downstream of Trask Avenue to the Haster Basin outlet, representing a total channel reach of 4,843 feet. It includes the street crossings at Trask Avenue, Pearce Street, Garden Grove Freeway, Garden Grove Boulevard, and Aspenwood Lane.

Because of the varying slopes in the downstream channel, it was analyzed with two different downstream water surface controls. The first model was run with the critical depth as the downstream control, and the second model was run with the water level one foot below the top of the channel lining. The two models generate the same water surface elevations between Pearce Street and the Haster Basin outlet. This is because the transition reach upstream of Trask Avenue was constructed with a steep slope, which results in a hydraulic jump at the Trask Avenue reinforced concrete box culvert for both downstream control conditions, effectively being the control section for the upstream reaches.

The hydraulic analyses were conducted with basin outflows ranging from 360-cfs to 450-cfs. The results are summarized in Table 3-3.

TABLE 3-3
EXISTING C05 CHANNEL HYDRAULIC ANALYSIS

Trask Avenue		Pearce Street		G.G. Freeway		G.G. Boulevard		Aspenwood Lane	
Q	WS	Q	WS	Q	WS	Q	WS	Q	WS
610	94.6	610	97.7	610	100.8	360	103.4	360	106.8*
650	94.8	650	98.0	650	101.1	400	103.9	400	107.0**
660	94.9	660	98.0	660	101.2	410	103.9	410	107.1***
680	95.0	680	98.1	680	101.3	430	104.1	430	107.2****
700	95.1	700	98.2	700	101.3	450	104.2	450	109.8*****

* *Original design flow provides 6.9 inches of freeboard at Aspenwood Lane (inside RCB)*
** *The channel freeboard of 3.8 inches at Aspenwood Lane (inside RCB)*
*** *The channel freeboard of 3.0 inches at Aspenwood Lane (inside RCB)*
**** *The channel freeboard of 1.4 inches at Aspenwood Lane (inside RCB)*
***** *The channel freeboard of 0.3 inches at Aspenwood Lane (inside RCB)*

Even with the original design flows, only minimal freeboard can be realized at the Aspenwood Lane box culvert.

In order to provide additional freeboard at Aspenwood Lane, the channel between the Basin outlet and the 10-foot wide by 4-foot high RCB can be modified as follows:

- Revise the channel slope to 0.001 between the Basin outlet and 5 feet upstream of the Aspenwood Lane RCB
- Provide a steep slope to the box culvert (0.088)

The results of the hydraulic analyses, presented in Table 3-4, show that nearly 8 inches of freeboard can be realized with a basin outflow of 450 cfs.

TABLE 3-4
MODIFIED EXISTING C05 CHANNEL HYDRAULIC ANALYSIS

Trask Avenue		Pearce Street		G.G. Freeway		G.G. Boulevard		Aspenwood Lane	
Q	WS	Q	WS	Q	WS	Q	WS	Q	WS
610	94.6	610	97.7	610	100.8	360	103.4	360	106.8*
650	94.8	650	98.0	650	101.1	400	103.9	400	107.0**
660	94.9	660	98.0	660	101.2	410	103.9	410	107.1***
680	95.0	680	98.1	680	101.3	430	104.1	430	107.2****
700	95.1	700	98.2	700	101.3	450	104.2	450	109.8*****

* *Original design flow provides 13.5 inches of freeboard at Aspenwood Lane (inside RCB)*
** *The channel freeboard of 10.8 inches at Aspenwood Lane (inside RCB)*
*** *The channel freeboard of 10.2 inches at Aspenwood Lane (inside RCB)*
**** *The channel freeboard of 8.9 inches at Aspenwood Lane (inside RCB)*
***** *The channel freeboard of 7.8 inches at Aspenwood Lane (inside RCB)*

Because of the increased freeboard that can be obtained, the channel section between the Basin outlet and the Aspenwood Lane RCB should be modified as described above.

An additional hydraulic analysis of the channel upstream of the Aspenwood Lane RCB was conducted to evaluate the impact of possible sealing of the RCB on the proposed seal weir at the pump station outlet. The analysis was conducted with the proposed design discharge of 400 cfs, and the water surface elevation at the entrance to the RCB 16 inches above the soffit of the box. The top of the seal weir is proposed to be at elevation 112.5 feet. The water surface elevation calculated at the seal weir was 109.84 feet, indicating that the seal weir operation would not be impacted by sealing of the RCB at Aspenwood Lane.

3-3 ULTIMATE CHANNEL CAPACITY

The 1994 Project Report did not recommend any improvements to the C05 Channel between the Basin outlet and Garden Grove Boulevard. Improvements to the downstream channel consisted of replacing the trapezoidal sections with rectangular channels to accommodate the expected value 100-year discharges.

Hydraulic analyses were conducted with the ultimate channel sections, including the modification recommended for the reach between the Basin outlet and Aspenwood Lane, and the design flows corresponding to basin outflows of 400 cfs and 450 cfs. The results of these analyses show that there would be a minimum of 8 inches and 4.6 inches of freeboard in the Aspenwood RCB, respectively.

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Section 4
HYDROGEOLOGIC CONDITIONS

4-1 BACKGROUND

In August of 2003, the County of Orange Materials Lab conducted a geotechnical investigation of the Haster Basin site for the purpose of developing design recommendations for the proposed improvements contained in the 2001 Preliminary Design Report (PDR).

Soil borings taken at the site encountered groundwater at a depth of approximately 20 feet (elevation 93 feet). The findings by the lab were unexpected. The PDR recommended project was predicated upon Basin storage being available down to elevation 89.5 feet. The loss of 3.5 feet of storage volume would invalidate many of the PDR's recommendations, and would require new grading and hydraulic studies be conducted.

Therefore, in April of 2004, the County authorized AKM and its subconsultant, Ninyo and Moore, to perform a hydrogeologic study of Haster Basin to confirm or refute the findings of the County's Materials Lab. The study was completed in June of 2004 and is summarized in the paragraphs below. The complete report prepared by Ninyo and Moore is included in the Section B of the Technical Appendices.

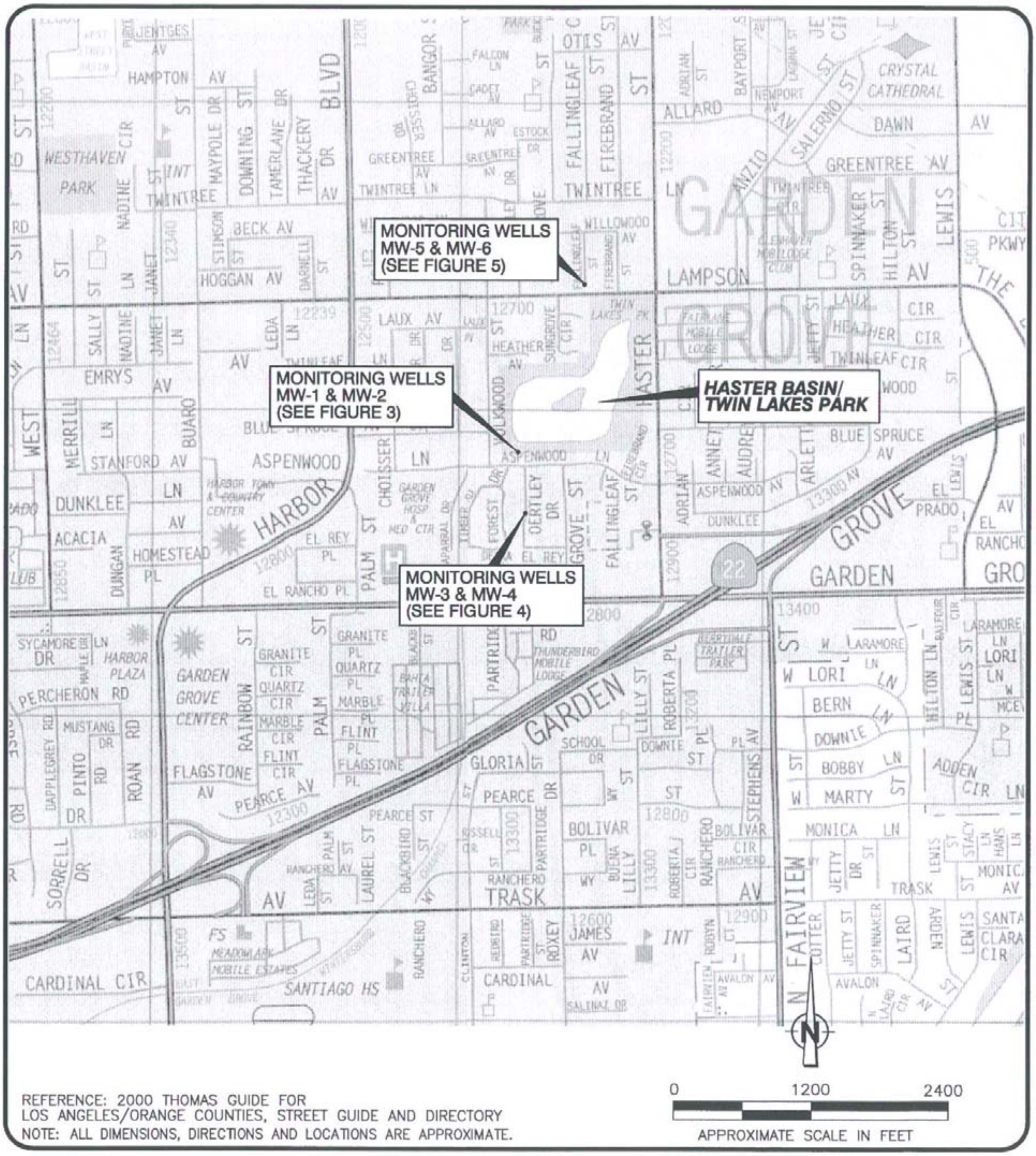
4-2 NINYO AND MOORE HYDROGEOLOGIC INVESTIGATION

4-2.1 Subsurface Evaluation

A subsurface investigation was conducted in May of 2004, which consisted of the drilling, logging and sampling of six small diameter wells located up gradient and down gradient from Haster Basin. The locations of these wells are generally shown on Figure 4-1. The monitoring wells were installed in pairs, one shallow and one deep, and screened at intervals to allow measurement of the relative piezometric head at different depths in the aquifer. Groundwater level measurements were made on three occasions during the study. Monitoring well readings are shown in Table 4-1 below.

TABLE 4-1
MONITORING WELL READINGS

Monitoring Well Reading		Pump Station Site		Down-Gradient Oertley Drive		Up-Gradient Falling Leaf Circle	
		MW-1 (Deep)	MW2 (Shallow)	MW-3 (Deep)	MW-4 (Shallow)	MW-5 (Deep)	MW-6 (Shallow)
First Reading June 1, 2004	Depth to Groundwater	35.7'	20.6'	26.9'	20.4'	31.8'	19.3'
	Groundwater Elevation (MSL)	78.0'	93.1'	81.4'	87.9'	82.7'	95.2'
Second Reading June 8, 2004	Depth to Groundwater	35.8'	20.7'	27.0'	20½'	32.0'	19½'
	Groundwater Elevation (MSL)	77.9'	93.0'	81.3'	87.8'	82½'	95.0'
Third Reading June 16, 2004	Depth to Groundwater	35.9'	20.9'	27.6'	20.6'	32.2'	19.7'
	Groundwater Elevation (MSL)	77.8'	92.8'	80.7'	87.7'	82.3'	94.8'



REFERENCE: 2000 THOMAS GUIDE FOR
LOS ANGELES/ORANGE COUNTIES, STREET GUIDE AND DIRECTORY
NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

Ninyo & Moore

MONITORING WELL LOCATION PLAN

HASTER BASIN/TWIN LAKES PARK
GARDEN GROVE, CALIFORNIA

PROJECT NO.	DATE	FIGURE
205715001	7/2004	2

EXHIBIT No. 4-1

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

MONITORING WELL
LOCATION MAP

$FILE$ 3/30/2010

4.2-2 Research for Existing Groundwater Data

A search for additional groundwater data was performed on facilities such as gas stations which typically maintain monitoring wells on-site. Four facilities were found for which data was available. The information showed groundwater levels to be between 19 and 25 feet below ground surface. The location of three existing monitoring wells for which data was obtained is shown on Figure 4-2.

4.2-3 Study Findings

Based upon the information gathered, the following conclusions were made:

A. A shallow aquifer is present below Haster Basin. It is estimated to be 20 feet below ground surface, which corresponds to elevations ranging from 94-feet in the north part of the Basin, to elevation 89-feet in the south part of the Basin. Estimated groundwater contours are shown on Figure 4-2. These contours exclude the localized effects from lake leakage.

B. The shallow aquifer extends to approximately 45 feet below ground surface at Haster Basin (approximate elevation 68-feet). A deeper partially confined aquifer was found below 45 feet, but is considered to be separate from the shallow aquifer, being separated by a 2½-foot clay lens.

C. The groundwater elevations of the deeper aquifer range from approximate elevations 78-83 feet. The deep aquifer is not anticipated to contribute to the recharge of Haster Basin.

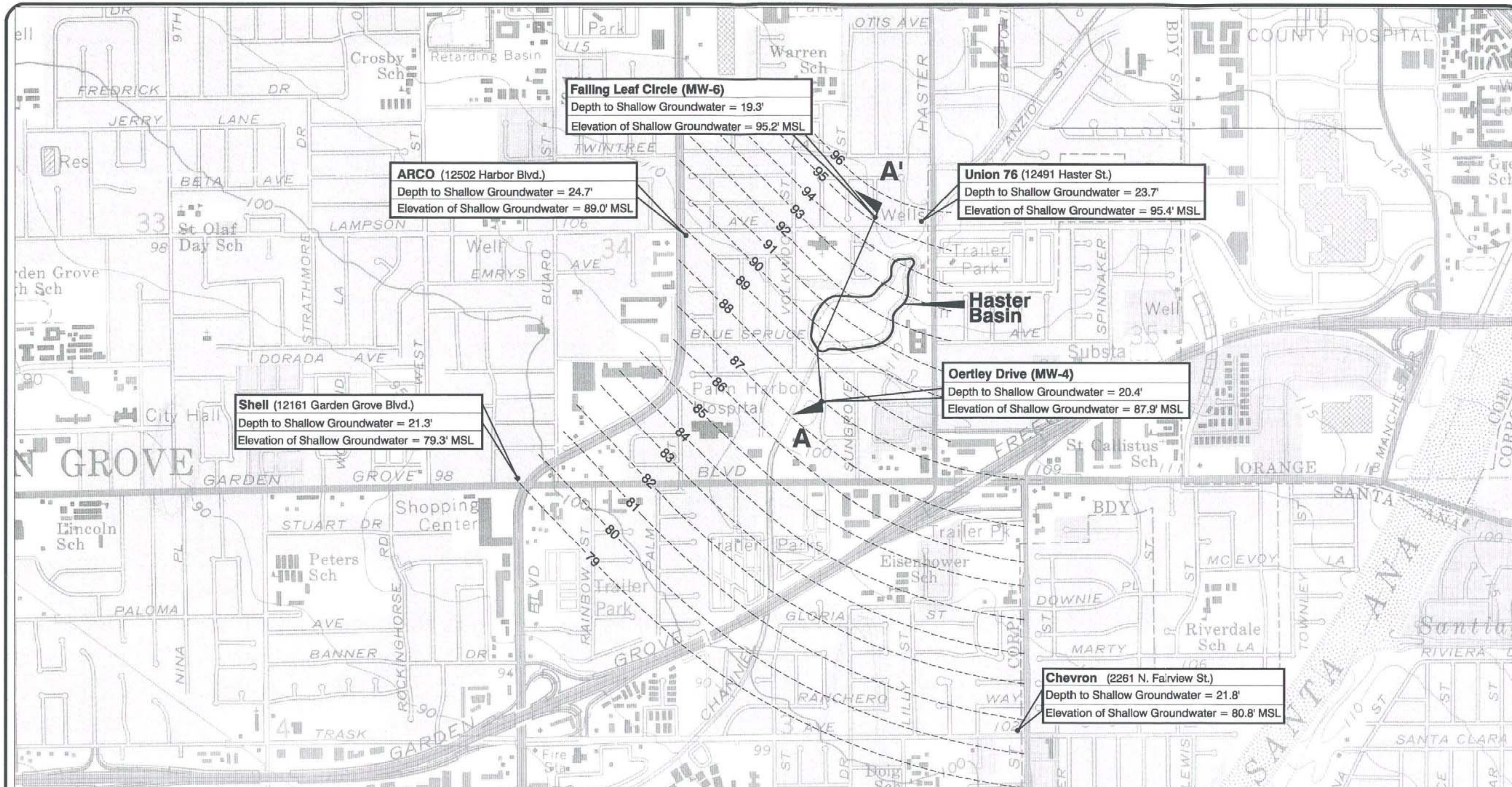
D. The surface elevation of the shallow aquifer beneath Haster Basin is estimated to be at approximate elevation 92 feet, not including lake leakage effects. The data suggests that this shallow aquifer is likely recharged by irrigation and seasonal precipitation.

E. Groundwater levels will fluctuate, and increases should be planned for accordingly. The groundwater levels measured during the study were obtained in the summer following a period of below average rainfall. The groundwater table could rise as a result of increased precipitation.

4-3 GROUNDWATER LEVEL MEASUREMENTS, SUBSEQUENT TO COMPLETION OF THE HYDROGEOLOGIC STUDY

The Ninyo and Moore study cautioned that the report findings were predicated upon groundwater measurements performed in the summer, following a winter of below average rainfall.

The winter of 2005 saw record rainfall totals for Southern California. In order to evaluate the impact of the heavy rains on the groundwater levels at Haster, AKM arranged for the City of Garden Grove to sound the monitoring wells between January and May of 2005. These level measurements are presented in Table 4-2. The results show an increase in the groundwater level of approximately 4 feet, which would correspond to a shallow aquifer water surface elevation under Haster Basin of 96 feet.



LEGEND

-----85----- APPROXIMATE ELEVATION OF SHALLOW GROUNDWATER IN FEET (MSL)

A — A' APPROXIMATE LOCATION OF CROSS SECTION

REFERENCE:
7.5 MIN USGS TOPOGRAPHIC MAP OF ANAHEIM, CALIFORNIA QUADRANGLE DATED 1965 (PHOTO REVISED 1981).
NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

N

0 1000 2000
APPROXIMATE SCALE IN FEET

Ninyo & Moore

SHALLOW GROUNDWATER CONTOUR MAP

HASTER BASIN/TWIN LAKES PARK
GARDEN GROVE, CALIFORNIA

PROJECT NO.	DATE	FIGURE
205715001	7/2004	7

EXHIBIT No. 4-2

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

SHALLOW GROUNDWATER CONTOUR MAP

$FILE$ 3/30/2010

TABLE 4-2
HASTER BASIN MONITORING WELL
(all measurements in feet below ground surface)

Date	Twin Lakes Park		Oertley Drive		Fallingleaf Street	
	MW-1 (deep)	MW-2 (shallow)	MW-3 (deep)	MW-4 (shallow)	MW-5 (deep)	MW-6 (shallow)
1/10/2005	50.00	18.00	44.00	17.50	17.50	30.00
1/17/2005	34.00	16.00	43.00	17.00	15.00	29.00
1/24/2005	35.00	17.00	--	16.00	16.00	29.00
1/31/2005	33.00	16.00	43.00	16.50	16.00	28.00
2/7/2005	33.00	17.00	44.00	17.00	16.50	29.00
2/28/2005	32.00	15.50	42.50	15.50	14.00	27.00
3/8/2005	32.50	15.50	42.00	15.50	15.00	28.00
3/14/2005	32.00	16.00	43.00	15.50	14.50	28.00
3/21/2005	33.00	16.00	42.50	--	15.00	28.50
5/11/2005	32.00	16.00	42.50	16.00	14.80	28.00
Averaged Ninyo & Moore Measured Levels – 6/1/04 – 6/16/04	**35.8**	**20.7**	**27.2**	**20.5**	**19.5**	**32.0**

4-4 MODIFICATIONS TO THE 2001 CH_2MHILL REPORT RECOMMENDATIONS

To address the lost basin storage capacity due to high groundwater levels, a number of alternatives were considered at a concept level. These are summarized below, but are presented in greater detail in the Ninyo and Moore Report.

- Grading Design Changes – Modify Proposed Grading to Increase Basin Capacity Above the Groundwater Level – Approach will require regrading of entire Basin, pushing back the current top of slope, and increasing the gradient of the side slopes from 4:1 to a maximum of 2:1.

- Permanent Basin Dewatering – Perpetual Dewatering of the Basin to Elevation 89.5 Feet – Inflow rates into the Basin cannot be accurately determined without test pumping and further analysis. Based upon soil transmissivity data, inflows could range between 54 and 1400 cfs. Permanently lowering the groundwater level could cause subsidence of the soil in the surrounding area, damaging structures. It could also create a zone of influence impacting groundwater contamination plumes. The approach is also energy intensive.

- Sheet Piles – Drive PVC Sheet Piles Around the Perimeter of the Basin into the Clay Lens Located at Approximate Elevation 68 Feet – By intercepting the clay layer with sheet piles, a cofferdam would be created restricting horizontal flow into the Basin. Leakage past the cofferdam into the Basin was estimated to be 60,000-gal/day (42-gpm). This flow would be pumped out daily using a small sump pump installed at the pump station. However, the estimated inflow is predicated upon the clay lens being continuous. It is unlikely that the continuity of this clay layer could be determined with certainty, and pumping rates to control the inflow could be substantially larger. In addition, the disposal of dry weather run-off by infiltration may no longer be possible if sheet piles were installed. And finally, sheet pile installation can be very disruptive to the surrounding community, and could cause damage to homes in the area.

- Basin Liner – Install a Concrete Liner to Maintain a Dry Basin Below the Water Table – The liner would need to be designed to resist 8-feet or more of hydraulic head. Several hundred piles could be required to resist this uplift force. The disposal of dry weather flows by infiltration would be precluded with the Basin liner in place.

Of the alternatives considered, only regrading the Basin was found to be feasible to implement without creating collateral negative impacts. Therefore, regrading the basin to provide the necessary storage volume over the estimated groundwater level of 92-feet is recommended.

4-5 DEWATERING OF HIGH GROUNDWATER LEVELS FROM THE BASIN

Groundwater levels can fluctuate, and have been observed 4-feet in excess of the estimated 92-foot level provided in the hydrogeologic study. To address higher than expected groundwater levels, it is proposed that pumping be used to lower the Basin level to the required elevation needed for 100-year flood protection.

Because dewatering the Basin would pump groundwater downstream, a meeting was held with representatives from OCWD to discuss this potential scenario. The meeting was held in May of 2005 at which representatives from the County and AKM presented the proposed operation. After considering the matter, OCWD personnel stated that they had no concerns regarding the potential Basin dewatering, and that the $212-ac-ft fee that is assessed to all pumpers would not be charged. No written response, however, was ever provided by OCWD.

4-6 ADDITIONAL STUDIES

The Hydrogeologic Report was unable to accurately quantify the amount of groundwater that would flow into the Basin under dewatered conditions. This information is needed for the following purposes:

- Sizing of the sump pump to evacuate all water from the Basin for maintenance.
- Design of a dewatering system by the Contractor selected to grade the Basin, and construct the pump station.
- To determine the pumping rate required to dewater the Basin during periods of high groundwater.

Ninyo and Moore's original proposal for the hydrogeologic study, dated March 2004, contained an optional scope of work for test pumping at the site to more accurately determine dewatering rates. This scope was as follows:

- Drill and install a 4-inch diameter PVC groundwater monitoring well with 40 feet of screen to a depth of approximately 60 feet below the ground surface at the pump station site. Previously installed wells would be used for monitoring drawdown during pump testing.
- Develop the well for a minimum of 3 hours.
- Perform a relative survey (horizontal/vertical) of the wells.
- Perform a step drawdown test in the proposed pumping well.
- Perform a short term, 8-hour pumping test, and monitor water levels before, during and after at each monitoring well.
- Prepare a report describing the field activities, pumping test analysis, and the results of the pumping test.

It is strongly recommended that the County authorize this study.

Section 5
BASIN GRADING AND HYDRAULICS

5-1 INTRODUCTION

The 2001 Preliminary Design Report recommended that the County pursue an alternative which included the construction of a new 375-cfs pump station, and regrading of the Basin's lower lake to eliminate the "island" which currently exists. The upper lake located at the outlet of the East Garden Grove-Wintersburg Channel would remain as would the current Basin top of slope. The Basin bottom was designed to be at elevation 87.5-feet. The hydraulic calculations included 2 feet of dead storage for a water quality wet pond. The minimum pumping level which the hydraulic calculations were based was elevation 89.5-feet.

The grading proposed by the 2001 Preliminary Design Report did not have an access road to the pump station sump nor did it address the grading required to modify the outlet structures of the two influent storm drains. In all, a total of 42,000-cy of earthwork was estimated by the study.

At the time of the 2001 Report, the groundwater conditions at the site were not known. As determined by Ninyo and Moore in their 2004 hydrogeologic investigation (see Section 4), the groundwater level at Haster Basin is estimated to be at elevation 92 feet near the pump station site. This finding invalidates the recommendations of the 2001 Preliminary Design Report which were predicated upon storage volume being available to elevation 89.5 feet, and requires the proposed grading concept to be re-evaluated. This section of the report will address grading requirements to meet all defined project objectives and criterion stated below.

- *Design Inflow* – 100-year expected value (50% confidence level) 3-day storm, with a peak flow of 2,200-cfs; and a volume of 554 ac-ft
- *Maximum Basin Water Surface* – Elevation 108 feet
- *Maximum Downstream Channel Capacity* – 400-450 cfs
- *Minimum Pumping Level* – Elevation 92 feet (to limit the pumping of groundwater to when it exceeds the normal groundwater level))

In addition, the grading design will include an access road to the front of the pump station sump apron for maintenance of the trash rack. It will also address modifications to the Oertley and East Garden Grove-Wintersburg Channel outlet structures as discussed in Section 5 of this report.

5-2 VERIFICATION OF THE INFLUENT FLOW

The project scope for the Preliminary Design Report included a review of the 2001 Hydrology Study completed by the County titled, "Hydrology Report, Haster Basin Facility No. C05 B02 - Total Inflow Including Contributions from the East Garden Grove-Wintersburg Channel (C05) and Oertly Storm Drain (C05P19)."

The report provides the expected value peak inflow to Haster Basin for various storm events, including a multi-day 100-year runoff. The results of the expected value 100-year, multi-day storm were as follows:

	1-Day	2-Day	3-Day
Peak Runoff	279.95 cfs	808.47 cfs	2192.23 cfs
Runoff Volume	83.9 ac-ft	219.6 ac-ft	553.9 ac-ft

AKM Consulting Engineers verified these values with the use of the LAPRE and HEC-1 programs. The results are also consistent with the 100-year expected value peak discharge presented in the 1994 Project Report. Therefore the current hydrology is considered to be accurate and has been used in all subsequent hydraulic analyses of the Basin and proposed pumping system contained within this report.

5-3 GRADING ALTERNATIVES

Three grading alternatives were initially developed for the Haster Basin site. These were as follows:

- Dry Basin Bottom
- Dry Basin Bottom with a Small Upper and Lower Lake for Water Quality Purposes
- Wet Basin Bottom

The County has elected to move forward with a Wet Basin alternative as it provides the greatest water quality benefit for the project. All operational scenarios will be therefore analyzed based upon a Wet Basin condition.

5-4 BASIN GRADING

General

The high groundwater discovered at Haster Basin has reduced the storage volume which is available to attenuate the 100-year storm peak inflow. In order to limit the maximum water surface elevation in the Basin to no more than 108.0-feet, an additional 40-ac-ft. of volume must be created beyond that proposed in the 2001 Preliminary Design Report, and 50 ac-ft. greater than that which currently exists at the site. This additional volume cannot be generated by digging the Basin deeper, as the bottom is already below the current groundwater level. Therefore the extra storage must be obtained by widening the Basin, which will increase the overall surface area of the lake.

Proposed Grading Plan

The proposed grading will maintain the current Basin bottom elevation of 87.0 feet. Side slopes, which are normally under water or near the land water interface, will be graded at a slope of 4:1. This will allow a person that may have fallen into the lake the ability to walk out onto the shore. Because it is proposed that dry weather flows be held in the Basin during the summer months, this 4:1 grading will extend to elevation 101.0 feet (the anticipated normal water surface elevation during the summer operation is 100-ft). Above elevation 101.0 feet, the side slopes will be graded at an incline of 2:1 until they daylight at approximately elevation 110.0 feet. The bottom at the East Garden Grove-Wintersburg Channel outlet will be sloped at 10:1 from elevation 95.0 feet to elevation 90.0 feet. From elevation 90 feet, the bottom will be gradually sloped toward the pump station to an elevation of 87.0 feet. The Basin bottom from the Oertly Storm Drain outlet structure will also sloped at 10:1, from elevation 99.0 feet at the structure to the Basin bottom at elevation of 87.0 feet.

Included in the grading concept is a 20-foot wide concrete roadway to the apron of the pump station sump. This roadway is required for maintenance of the pump station trash rack.

The proposed Basin grading will increase the total storage volume to approximately 207 ac-ft. (at elevation 108.0 feet), which is 54 ac-ft. more than is currently available.

The Basin volume between elevation 92.0 feet, which is the estimated groundwater level, and elevation 87.0 feet, which is the Basin bottom, would be dead storage used for water quality purposes (volume = 30 ac-ft.). This represents a 3-foot increase in depth and 23 ac-ft. increase in volume over that recommended in the 2001 Preliminary Design Report, providing an improved water quality benefit.

The proposed Basin grading is shown on Figure 5-1. A graph relating Basin volume to elevation is provided on Figure 5-2. A cross-section depicting the proposed grading is shown on Figure 5-3. Estimated earthwork quantities for the concept grading plan are:

- Cut – 100,000-cy
- Fill – 25,000-cy

Usable park area will be reduced by approximately 37% as a result of enlarging the Basin.

Figure No. 5-1

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

HASTER BASIN
PROPOSED BASIN GRADING

$FILE$ 3/30/2010

HASTER BASIN PUMP STATION PROJECT

Basin Volume Calculation Method

In General :

1. The ultimate condition is to grade the basin side slope of 4(H) : 1(V).
2. The interim condition is to keep the existing basin in place, and remove the central island only.
   No additional grading shall be performed.

Method to Calculate the Basin Volume :

The Conic Method is used to compute the incremental volume between elevation interval.
The incremental volumes are then added to generate a volume rating table of cumulative basin volumes.

$$\Delta V_{1\text{-}2} = H_{1\text{-}2} * (A_1 + A_2 + (A_1 * A_2)^{0.5}) / 3$$

where: A = Surface area
$H_{1\text{-}2}$ = Vertical height between EL_1 and EL_2
$\Delta V_{1\text{-}2}$ = Volume between areas 1 and 2

4:1 Side Slope of Proposed Basin			
Elev.	Area	Volume	
(ft)	(ft^2)	(ft^3)	(ac-ft)
87	41858.757	0	0.000
88	155489.77	92674.825	2.128
89	277906.27	306431.49	7.035
90	337343.2	613576.61	14.086
91	351706.28	958076.39	21.994
92	368732.66	1318262.3	30.263
93	383268.04	1694239.3	38.894
94	398255.04	2084976.8	47.864
95	414457.26	2491306.1	57.193
96	430584.6	2913801.4	66.892
97	446197.03	3352169	76.955
98	461241.3	3805867.4	87.371
99	475806.19	4274372.3	98.126
100	491466.42	4757987.4	109.228
101	506154.91	5256780.1	120.679
102	514862.04	5767282.4	132.399
103	523384.39	6286399.8	144.316
104	532032.39	6814102.2	156.430
105	541088.86	7350656.5	168.748
106	549534.95	7895963	181.266
107	557832.59	8449641.5	193.977
108	566210.74	9011658	206.879
109	574665.82	9582091.1	219.975
110	596373.3	10167577	233.415
111	600257.52	10765891	247.151
112	650461.48	11391083	261.503

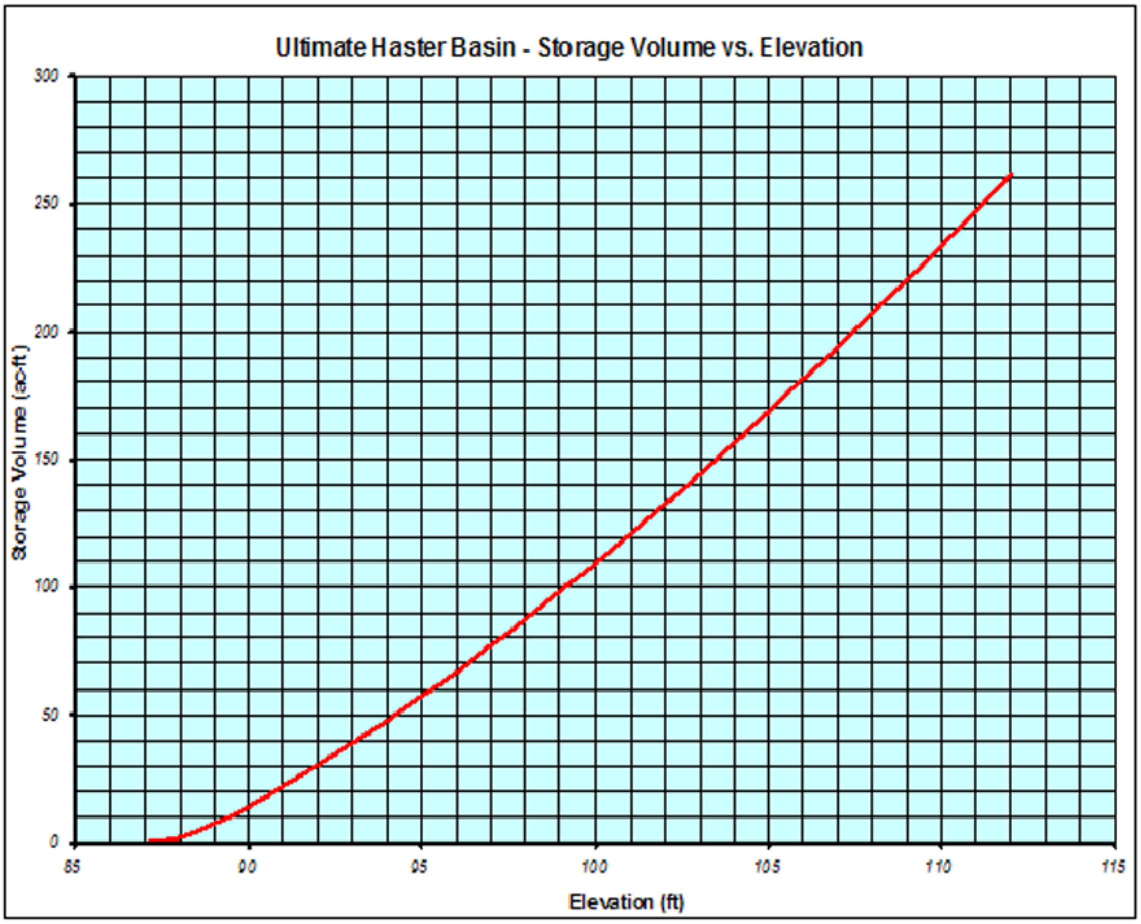

Figure No. 5-2

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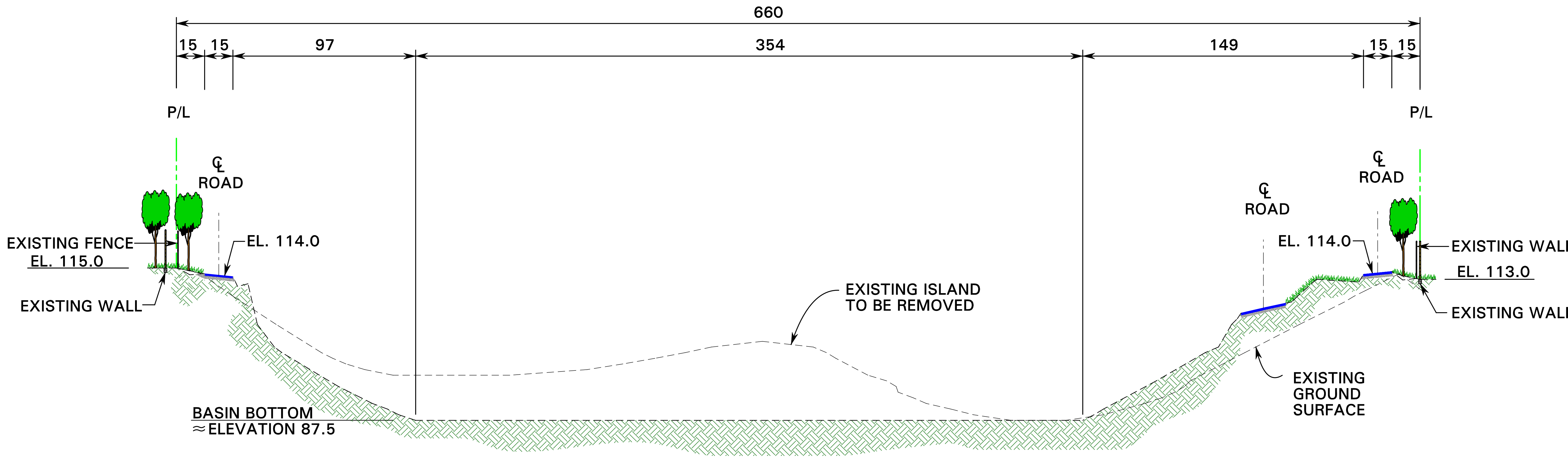
HASTER BASIN/TWIN LAKES PARK PUMP STATION

STORAGE VOLUME VS. ELEVATION
PROPOSED GRADING



CROSS-SECTION

Figure No. 5-3

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

PROPOSED BASIN GRADING
CROSS-SECTION

$FILE$ 3/30/2010

5-5 HYDRAULIC ANALYSIS

5-5.1 Proposed Grading Plan

The inflow hydrographs were routed through the proposed basin grading, and pump station alternatives using the HEC-1 program. The pump station was assumed to incorporate three 133 cfs pumps which are staged to turn on at intervals that would provide a minimum of 20 minute run time. The on-off elevations for the pumps were set as follows:

	On Level (ft. amsl)	Off Level (ft. amsl)	Volume (ac-ft.)	Run Time(min.)
Pump 1	93.0	92.0	8.6	47
Pump 2	93.5	92.0	13.1	36
Pump 3	94.0	92.0	17.6	32

It was assumed that pump output remains constant despite varying head conditions.

The results of the Hydraulic Analysis are shown in Table 5-1.

TABLE 5-1
RESULTS OF HYDRAULIC ANALYSIS
PROPOSED GRADING CONDITION

Storm	Max Basin WS Elevation (ft. amsl)	Basin WS Elevation at End of Day (ft. amsl)	Max Pump Station Output (cfs)
Day 1	93.5	92.2	267
Day 2	96.0	92.7	400
Day 3	107.9	98.5	400

The analysis shows that the pump station would empty the Basin of the first two days of runoff prior to the third day. The maximum water surface elevation in the Basin would be 107.9 feet which meets the project criteria (EL 108.0 Max).

The hydraulic calculations for the proposed Basin grading condition can be found in Section F of the Technical Appendices.

5-5.2 Spillway Hydraulic Analysis

The existing Basin spillway is set at elevation 110.0 feet. Water discharged through the spillway flows over the access road, parallel to the C05 downstream channel, into Aspenwood Lane. The width of the existing spillway is 25 feet.

The 2001 Preliminary Design Report provided recommendations for the design of the Basin's overflow spillway. These recommendations are as follows:

- *Design Flow* – 100 year storm event should be used, as floods higher than those resulting from the expected value 100-year event cannot be conveyed into the Basin.

- *Pumping Condition* – One pump fails to operate during the expected value 100-year flood event.

- *Maximum Pumping Elevation* – The maximum pumping elevation should be set at 113-feet which is approximately 6-inches below the top of the lowest Basin levee.

The bottom width of the proposed spillway is a 25-foot open channel. A cross section of the spillway is shown on Figure 5-4. Hydraulic simulations were run with the lead pump failed, the lag pump failed, and the lag lag pump failed. The highest Basin elevation occurred when the lead pump failed and was 110.9-feet. The corresponding flow through the spillway was 198 cfs. The hydraulic analysis confirms that the proposed 25-foot spillway will meet the criterion established for this project. The rating curve for the proposed spillway up to elevation 111.0 feet is shown on Figure 5-5.

The spillway hydraulic calculations are located in Section E of the Technical Appendices.

5-6 GEOTECHNICAL REVIEW OF PROPOSED GRADING

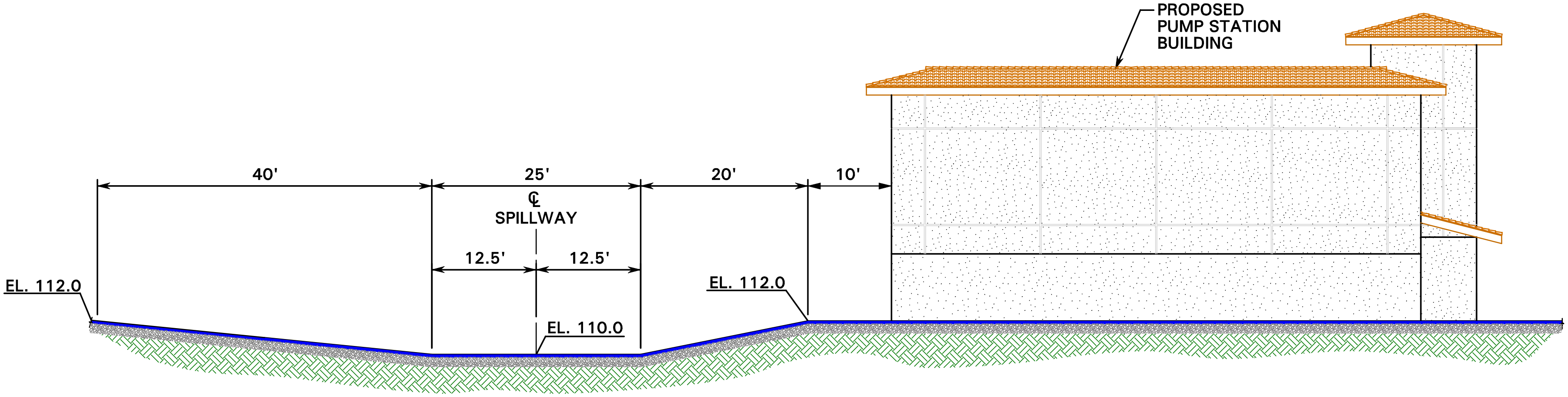
As part of the Geotechnical Report prepared by Ninyo and Moore for the project, a slope stability analysis of the proposed grading was conducted. The analysis showed that the proposed 2:1 slopes would have a factor of safety of greater than 1.5 and 1.1 under static and pseudo-static conditions, respectively. The results are in accordance with accepted geotechnical practices and County of Orange guidelines.

A summary of the project geotechnical study is provided in Section 9 of this report. The complete geotechnical study document can be found in Section G of the Technical Appendices.

5-7 GRADING IMPACT ON EXISTING TREES

There are a number of tree species located in and around the Haster Basin site. These include willow, pine, sycamore, alder and peppermint, which were planted when the park was developed in 1976. In total, there are approximately 301 mature trees located throughout the park, including the parking lot. The proposed grading of the Basin and construction of the perimeter road and pump station will require many of these trees to be removed.

Figure 5-6 shows the trees which will be impacted. Approximately 98 trees that are located within the project work limits will be removed. However, many of the trees may be replaced after construction, but not as many as were removed because less usable space will be available.



SPILLWAY CROSS-SECTION

Figure No. 5-4

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

CROSS-SECTION OF
PROPOSED SPILLWAY

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Haster Basin Outlet System Rating Curve Table

Water Surface Elevation (ft)	Spillway Outflow Rates (cfs)
110.1	5.3
110.2	16.8
110.3	32.8
110.4	52.7
110.5	76
110.6	102
110.7	132
110.8	164
110.9	198
111	235

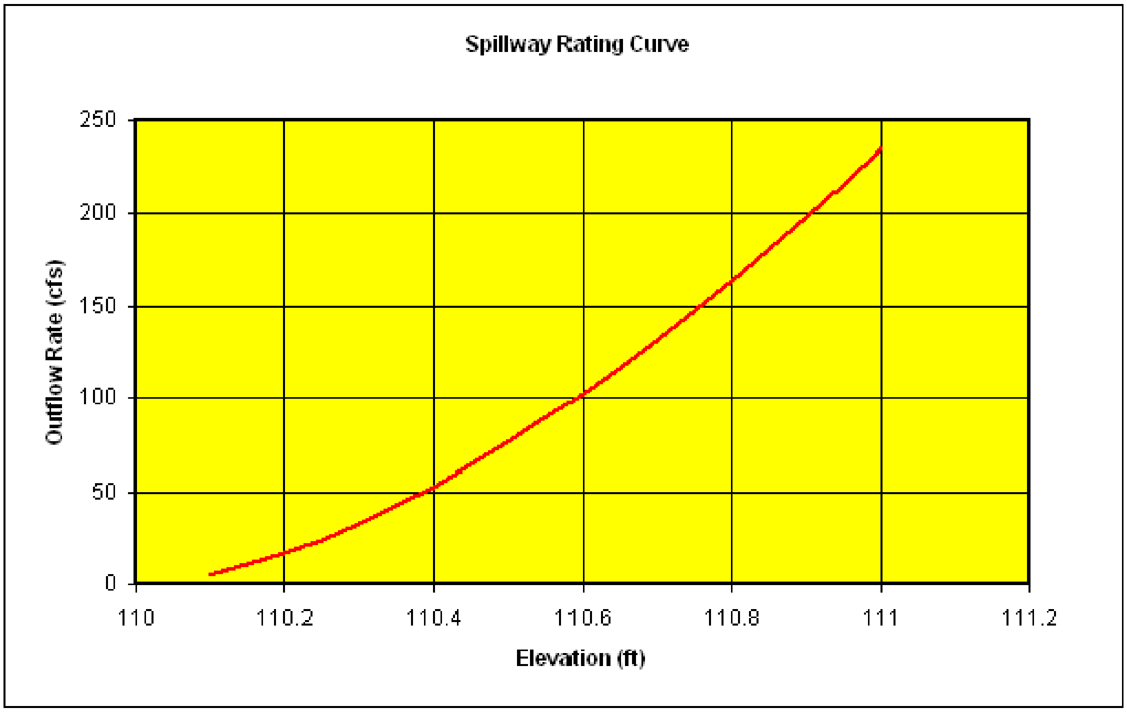

Figure No. 5-5

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

PROPOSED SPILLWAY
RATING CURVE

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LEGEND

TREES TO BE REMOVED

TREES TO PROTECT IN PLACE

Figure No. 5-6

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

EXISTING TREES TO BE REMOVED

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It maybe possible to dig up, box, and replant some the more desirable trees so that an established landscape feel is created almost immediately following the completion of construction. The feasibility and the costs associated with preserving the existing trees in this manner are currently not known. An arborist should be consulted if this option is to be explored in detail.

5-8 COSTS

Estimated Basin Grading cost is provided in Table 5-2 below. All costs presented are based on an ENR Index of 9183 (February 2008).

TABLE 5-2
ESTIMATED BASIN GRADING COST

Item	Quantity		Unit Cost		Total Cost
Clearing and Grubbing	20	sf	$10,000	sf	$200,000
Earthwork	125,000	cy	$30	cy	$3,750,000
Hauling	75,000	cy	$20	cy	$1,500,000
Dewatering	LS				$1,000,000
Total					$6,450,000
Contingency	15%				$967,500
Total Estimated Grading Cost:					**$7,417,500**

Section 6
GEOTECHNICAL INVESTIGATION

6-1 INTRODUCTION

In May of 2005, the County authorized AKM and its subconsultant, Ninyo and Moore, to proceed with the preparation of a geotechnical study to provide analysis and design recommendations for the proposed Haster Basin improvements. This work included the following:

- Suitability of the site for the planned construction
- Excavation and compaction requirements including earthwork recommendations for the proposed grading
- Slope stability analysis of the Basin perimeter slopes
- Pump station design recommendations for:
  - Foundations
  - Below grade walls
  - Uplift
  - Seismic Hazards
  - Corrosion
  - Concrete placement
  - Liquefaction

A summary of Ninyo and Moore's geotechnical report findings is provided in the following sections. The complete report is included in Section G of the Technical Appendices.

6-2 SUBSURFACE INVESTIGATION

Four borings located along the perimeter of the Basin were drilled on July 5, 2005 (as part of the Geotechnical study) to a depth of approximately 30 feet below the existing grade. The soils encountered were primarily poorly graded silty sands. Groundwater was encountered from approximately 14 feet to 17 feet below ground surface (BGS) (elevations 94 feet to 97 feet). Soil boring locations are shown on Figure 6-1. The figure also shows two borings in the southwest corner of the Basin that were drilled in May 2004 (as part of the hydrogeologic study) to depths of 30 and 76 feet. Boring logs from the Ninyo and Moore Study are presented at the end of this section.

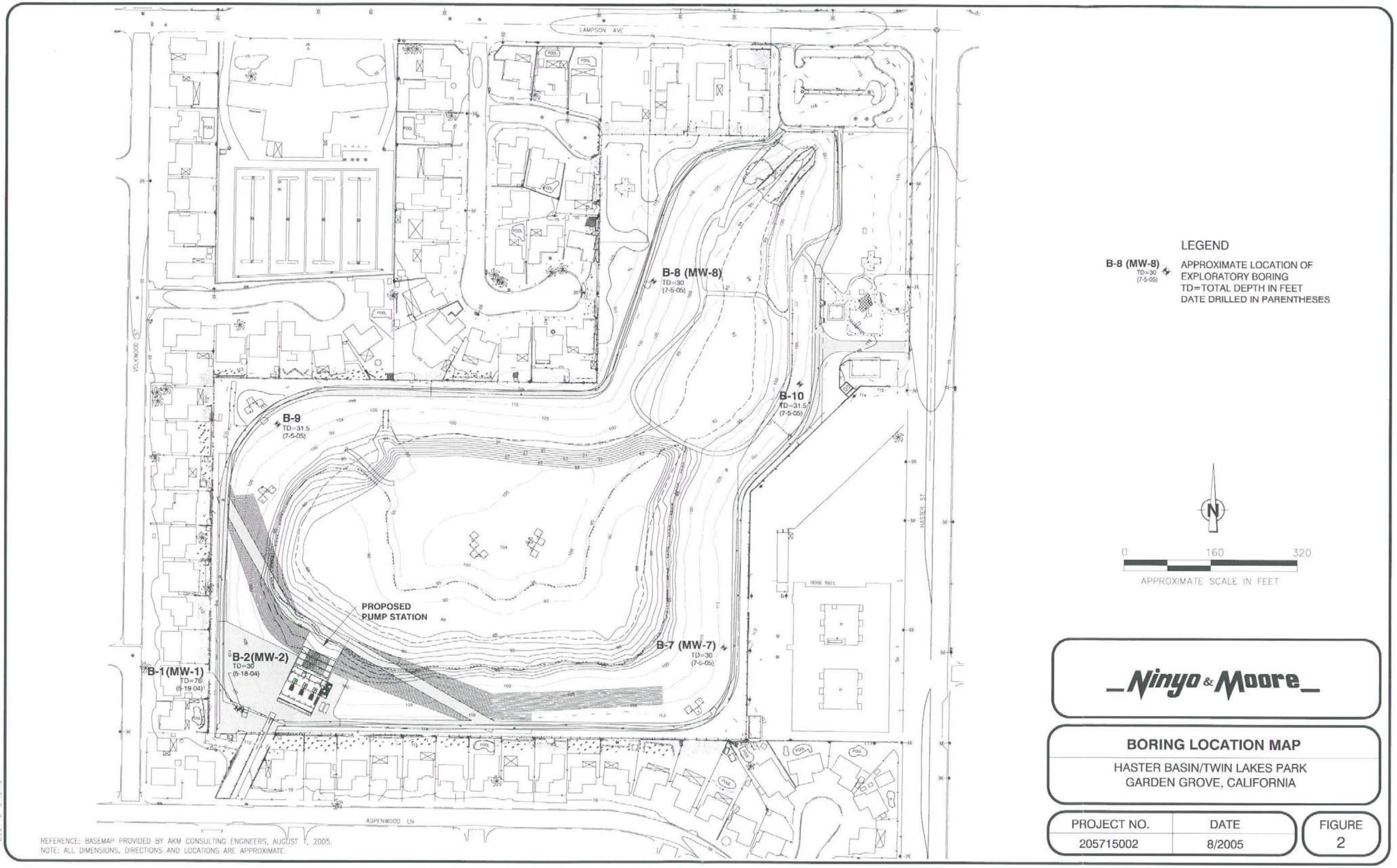


Figure No. 6-1

AKM	AKM Consulting Engineers 553 Wald Irvine, Ca. 92618 (949) 753-7333	ORANGE COUNTY PUBLIC FACILITIES & RESOURCES DEPARTMENT HASTER BASIN/TWIN LAKES PARK PUMP STATION SOIL BORING LOCATION MAP

$FILE$ 3/30/2010

6-3 GEOLOGY

The site is situated on the plains of the Los Angeles Basin between the San Gabriel River to the west, and the Santa Ana River and Santa Ana Mountains to the east. The Los Angeles Basin is part of the Peninsular Ranges Geomorphic Province. The project area is underlain by Holocene and late Pleistocene-age alluvial fan deposits consisting predominately of gravel, sand and silt.

6-4 SEISMICITY

6-4.1 Active Faults

The nearest active fault to the site is the on-shore segment of the Newport-Inglewood fault located 8.8 miles to the southwest. The active Elsinore-Whittier fault zone is located approximately 10.8 miles northeast of the site. No active or potentially active faults are known to underlie the project site.

6-4.2 Peak Ground Acceleration

The peak ground acceleration that may be expected at the site during an earthquake is 0.38g. This value has a 10% probability of being exceeded in 50 years, which are the typical criteria for structures such as those being considered at Haster Basin.

6-4.3 Liquefaction

The Haster Basin site is located in an area with potentially liquefiable soils. Liquefaction is known to generally occur in saturated cohesionless soils at depths of 50 feet or less from the ground surface. These types of soils were encountered at depths as shallow as 14 feet below the surface at the Haster site. A computer analysis showed that the soils located between the depths of 14 feet and 23 feet are susceptible to liquefaction and liquefaction related seismic events.

6-4.4 Dynamic Settlement

The pump station structure may be subject to liquefaction induced settlement. The post earthquake soil settlement is calculated at 2 inches for structures with shallow foundations. For structures founded below the potentially liquefiable layers, the post earthquake settlement is estimated to be on the order of 1 inch or less.

6-5 SLOPE STABILITY

The proposed grading plan will increase the inclination of the Basin slopes from 5:1 (horizontal to vertical) to 2:1. An analysis was performed to evaluate the stability of the steeper slopes and to determine the impacts of a rapid drawdown of water in the Basin on the slopes.

The analysis showed a factor of safety greater than 1.5 under static conditions and greater than 1.1 under pseudo static conditions. Both results are within accepted geotechnical practices and the County of Orange guidelines.

The factor of Safety was approximately 1.2 under rapid drawdown conditions.

6-6 PUMP STATION DESIGN RECOMMENDATIONS

6-6.1 Seismic

The pump station improvements are to be designed in accordance with applicable codes in Seismic Zone 4 and the Standard Practices of the Structural Engineers Association of California. UBC Seismic design parameters are shown in Table 6-1 below.

TABLE 6-1
1997 UNIFORM BUILDING CODE SEISMIC RECOMMENDATIONS

1997 UBC Seismic Design Factor	Value
Seismic Zone Factor, Z	0.4
Seismic Source Type*	B
Near Source Factor, N_a	1.0
Near Source Factor, N_v	1.0
Soil Profile Type	Sd
Seismic Coefficient, C_a	0.44
Seismic Coefficient, C_v	0.64

* *Faults are designated as Type A, B or C, depending on maximum moment magnitude and slip rates (Table 16-U of UBC, 1997).*

A dynamic uplift pressure on the pump station structure of 3000-psf may be used in design.

6-6.2 Mat Foundations

Loose, soft, or deleterious materials exposed at the foundation grade should be over-excavated and recompacted to 95% or more. A 1-foot thick crushed rock base course should be placed below the mat to provide a working surface. A net allowable bearing capacity of 4,000 PSF may be used for design, the total and differential settlements corresponding to this allowable bearing load are estimated to be less than 1-inch, and less than 1/2-inch over a horizontal span of 40 feet.

6-6.3 Lateral Earth Pressure

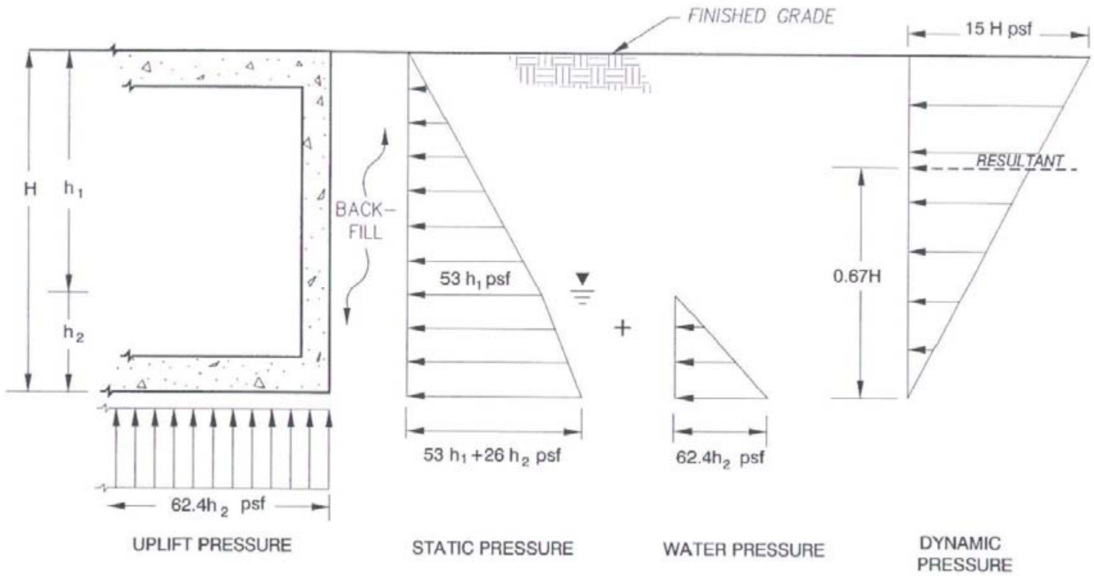
Below grade walls subjected to lateral earth pressures, above and below the water table should be designed in accordance with Figure 6-2.

6-6.4 Corrosion

Laboratory testing showed soils at the site are moderately corrosive to buried ferrous metals.

6-6.5 Concrete

Type V cement is recommended for all concrete in contact with soil. It is also recommended that concrete have a water-cement ratio of no greater than 0.45 by weight, and be placed with a slump of no greater than 4 inches.



NOTES:

1. GROUNDWATER TABLE
2. DOES NOT INCLUDE SURCHARGE PRESSURES CAUSED BY VEHICLES OR NEARBY STRUCTURES
3. DYNAMIC LATERAL EARTH PRESSURE IS BASED ON A PEAK GROUND ACCELERATION OF 0.38 g
4. H, h_1 AND h_2 ARE IN FEET

NOT TO SCALE

Ninyo & Moore

LATERAL EARTH PRESSURES FOR UNDERGROUND STRUCTURES

HASTER BASIN/TWIN LAKES PARK
GARDEN GROVE, CALIFORNIA

PROJECT NO.	DATE	FIGURE
205715002	8/2005	6

Figure No. 6-2

N

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

LATERAL EARTH PRESSURES
FOR UNDERGROUND STRUCTURES

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Section 7
PUMP STATION DESIGN

7-1 INTRODUCTION

The purpose of the pump station is to evacuate as much water from the Basin as the downstream channel will carry and therefore increase the available storage capacity of the Basin during a storm. Without the pump station, the upstream storm drains could not be increased in size to carry the 100-year storm flow (as required by the County's hydrology manual) without causing flooding to areas downstream of Haster Basin.

This section of the report provides analysis and recommendations for the design of a pump station which is similar in concept to the recently constructed Rossmoor Pump Station and the Los Alamitos Pump Station, which is currently under construction. Layout, equipment, materials, and electrical components will all take their cues from those other facilities.

Catalog information for selected pump station equipment is provided in the Technical Appendix Section I, and calculations are located in Technical Appendix, Section J. Concept design drawings are provided at the end of this section and should be referenced when reading this section.

7-2 PUMP SELECTION

7-2.1 Criteria

The basic criteria for pump selection is that a total pump station capacity of 400-cfs is required. The pumps must also be able to deliver their full operating capacity under all variations in Basin levels which are anticipated.

The capacity of each pump will depend upon the number of pumps supplied. The 1994 Project Report recommended a 7-pump system. The 2001 Preliminary Design Report recommendations were based upon a 3-pump layout. By providing more pumps, greater operational flexibility is achieved. However, there is also more equipment to maintain and the pump station footprint becomes larger. The goal is to provide the proper level of operational flexibility and redundancy which is also economical to construct, operate, and maintain, but limits the physical impact of the facility on the site. The pumps shall be the product of a manufacturer regularly engaged in the building of large, vertical, mixed flow pump column sizes of 60 inches or larger and shall be models which have been in regular production by the manufacturer for at least 15 years and be manufactured in the United States of America and have a factory authorized service center in the Southern California region for technical assistance and emergency repair.

A *7-PUMP SYSTEM*, as proposed by the 1994 Project Report, would result in unnecessarily small equipment which provides no operational advantage over a system with fewer pumps. It would also be more costly to maintain and require a larger footprint to construct.

Alternatives to a 3-pump facility, as recommended by the 2001 Preliminary Design Report, would include a 2-pump and 4-pump layout.

A *2-PUMP LAYOUT* would create a smaller building footprint, but would require larger equipment (550 pumping horsepower) that is not normally manufactured by vendors. Custom equipment is not only more expensive to purchase, but is also difficult to maintain. Additionally, a failure of one pump cuts the station's capacity in half, which could be disastrous. Because of a lack of redundancy and the need for special order pumps, engines, and right angle gear, a 2-pump solution is not considered feasible.

A *4-PUMP CONFIGURATION* provides greater pumping redundancy than a 3-pump arrangement, as three-fourths of the station's full capacity would be available if one pump were to fail. There are no other operational advantages to this arrangement. A smaller pump could be used, but the engine selection would be the same as for a 3-pump station. The building and sump would also be approximately 15 feet wider, adding project cost, and size to an already negative visual impact. As there are no significant operational advantages to a 4-pump system, and project cost and visual aesthetics are negatively impacted, it is not recommended for the Haster Basin project.

It is therefore proposed that 3-pumps be provided at the Haster Pump Station, as recommended by the 2001 Preliminary Design Report. Design capacity for each pump would be 133-cfs (60,000-gpm). The arrangement provides a reasonable level of capacity if a pump were to fail (266-cfs), and provides a smaller building footprint than a 4-pump layout.

The pumping head which must be delivered by each pump will vary according to the Basin level. Therefore determining the minimum and maximum Basin levels at which the pumps will operate is critical.

The minimum pumping level is established as the anticipated groundwater elevation underlying the Basin (92 feet). This will prevent groundwater, under normal conditions, from being pumped downstream.

The maximum pumping level has been selected for design purposes to be the anticipated water surface elevation in the Basin during the 100-year expected value storm, with one pump out of service. This is the same criteria used in the design of the Basin's spillway. This elevation is 111.0 feet. Table 7-1 summarizes the criteria used for pump design.

TABLE 7-1
PUMP DESIGN CRITERIA

Number of Pumps	3
Capacity Each Pump	133-cfs (60,000-gpm)
Minimum Pump Operating Elevation (Basin)	92.0 feet
Basin Elevation, 100-Year Expected Value Storm	108.0 feet
Maximum Pump Operating Elevation (Basin)	111.0 feet

Pump Operation: Pumps must be able to deliver full capacity (133-cfs each) at the lowest pumping level (elevation 92.0 feet). Pump speed will be modulated to maintain a constant downstream channel elevation (equivalent to 400-cfs)

Pump Start-Stop Levels
(From Hydraulic Analysis Contained in Section 5)

	Start	Stop
Pump 1:	93.0	92.0
Pump 2:	93.5	92.0
Pump 3:	94.0	92.0

Minimum Run Time: 20 Minutes

7-2.2 Pumping Heads

To properly select a pump, a system head curve must be developed. The system curve, like the head capacity curve of a pump, relates flow to head through a range of points. Since the head developed by the pump and the total dynamic head of the system must be equal, the operating point of any pump can be determined by superimposing the system curve on the pump characteristic curve. Where the two curves intersect determines the operating point of the pump.

The pumping head is the sum of the static lift, column losses, elbow losses, discharge pipe friction losses, and the velocity head. Each of these components is described below.

- *Static Lift* – The elevation difference between the water surface elevation in the Basin and the water surface elevation in the outlet channel or other control device.
    - Maximum static lift is the outlet channel water surface elevation flowing at 400-cfs (109.4 feet) less the minimum Basin pumping level (92.0 feet).
    - The minimum static lift is the outlet channel water surface elevation flowing at 400-cfs (109.4 feet) less the maximum Basin pumping level (111.0).
    - The design static lift is the outlet channel water surface elevation flowing at 400-cfs (109.4 feet) less the Basin pumping level when each pump is called to start (94.0 feet)

- *Column and Discharge Pipe Losses* – The friction loss through the column and discharge pipe is calculated by the Darcy-Weisbach equation:

$$H_f = f\left(\frac{L}{D}\right)\frac{V^2}{2g}$$

Where: H_f = Friction Loss
F = Friction Factor as determined from the Moody Diagram
L = Length of Pipe (ft)
D = Inside Diameter of Pipe (ft)
V = Velocity (ft/sec)
g = Acceleration Due To Gravity (32.2 ft/sec^2)

- *Elbow Losses* – Friction loss thorough pump discharge elbow, based upon the manufacturer's chart

- *Velocity Head* – The velocity head is the energy required by the pump to start the water flowing. It is defined by the following equation:

$$H_f = \frac{V^2}{2g}$$

- *Flap Valve Losses* – Energy losses through the flap valve on the discharge pipe are developed from manufacturer data.

System total dynamic head at various pumping rates are presented in Table 7-2. Figure 7-1 shows the system head data plotted on a pump operating curve.

Because of the low head condition which exists when the Basin level is above 111.0 feet, the pump would be operating outside of its performance curve range. Pumps which are run outside the limits of their performance curve generally cavitate and vibrate due to unbalanced forces on the impeller. Severe damage can be expected for pumps operated under these conditions.

To solve the problem, the pumps could be designed to shutoff if the Basin elevation exceeds 108.5 feet. Water would then flow by gravity through the pumps. However, it is considered unlikely that an operator would allow the pumps to shutdown under high water level conditions. Additionally, if flooding were to occur, it might be difficult to explain why the pump station was shut down when the Basin level was continuing to rise. Therefore, to ensure that the pumps will operate satisfactorily under all conditions, it is recommended that a seal weir be placed on the discharge of the pumps to control the pumping head.

With the use of a seal weir, a minimum level of positive pumping head could be guaranteed and thus assuring satisfactory operation of the pump. A disadvantage of this approach is that artificial head is being created which increases pumping horsepower by approximately 100-hp. The seal weir also prevents gravity flow through the pumps in the event of total station failure.

TABLE 7-2

SYSTEM PUMPING HEAD

Flow (gpm)	Pump Column Losses (ft)	Pump Elbow Losses (ft)	Discharge Pipe Losses (ft)	Velocity Head (ft)	Flap Valve Losses (ft)	Total Friction Losses	Total Dynamic Head Max (ft)	Total Dynamic Head Design (ft)	Total Dynamic Head Min (ft)	Total Dynamic Head Basin = 108 ft (ft)
30,000	0.05	0.10	0.07	0.27	0.02	0.51	17.9 (22.5)	16.9 (21.5)	-1.1 (3.5)	1.9 (6.5)
50,000	0.13	0.27	0.20	0.75	0.06	1.41	18.8 (23.4)	17.8 (22.4)	-0.2 (4.4)	2.8 (7.4)
60,000	0.20	0.40	0.30	1.11	0.09	2.10	19.5 (24.1)	18.5 (23.1)	0.5 (5.1)	3.5 (8.1)

With No Head Control at Outlet:				**With Seal Weir at Outlet:**			
Maximum Static Lift =	109.4 ft	- 92.0 ft	= 17.4 ft.	Maximum Static Lift =	114.0 ft	- 92.0 ft	= 22.0 ft
Design Static Lift =	109.4 ft	- 93.0 ft	= 16.4 ft	Design Static Lift =	114.0 ft	- 93.0 ft	= 21.0 ft
Minimum Static Lift =	109.4 ft	-111.0 ft	= - 1.6 ft	Minimum Static Lift =	114.0 ft	-111.0 ft	= 3.0 ft

NOTE: Total dynamic head with downstream head control (seal weir) shown in parenthesis

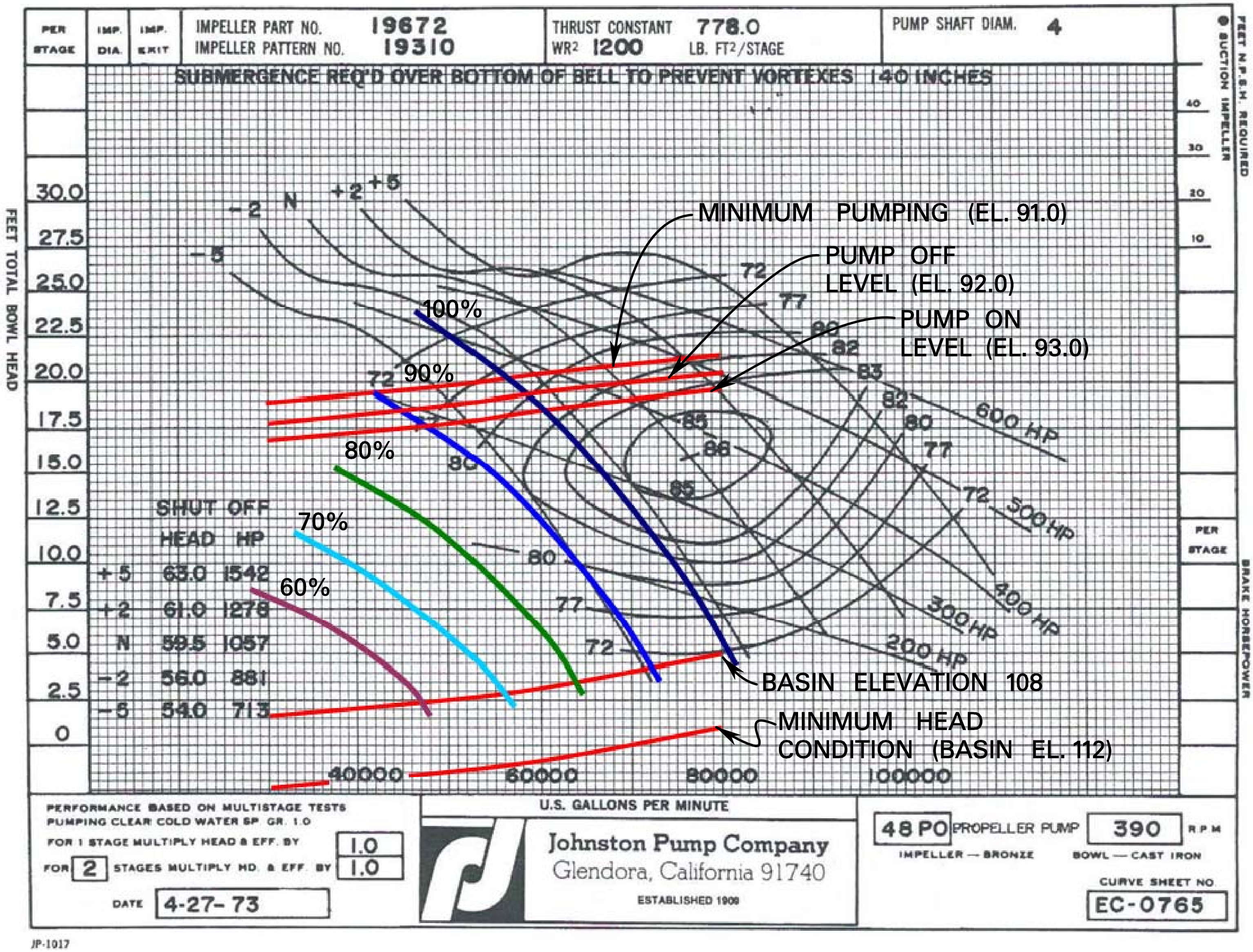

Figure No. 7-1

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

DESIGN CONDITION 60,588 GPM @ 18.5 FT TDH NO SEAL WEIR

$FILE$ 3/30/2010

This condition can however be alleviated by providing openings in the weir wall to the downstream channel sealed by slide gates. Normally, the gates would be closed and force water over the weir. If a failure of the pump station occurs, the gates could be opened to allow flow downstream.

To ensure satisfactory pump operation, the seal weir should be designed to produce a downstream water surface elevation of 114.0-ft. Table 7-2 lists system pumping heads with downstream weir control.

A number of different pumps were reviewed for the application. A Johnston 48 PO propeller pump operating at a speed of 390-RPM was selected as the best possible choice for the project. Figure 7-2 shows the pump's performance curve with the system head curve superimposed. As shown, the system curves at both the maximum and minimum head conditions intersect the pump performance curve. Anticipated pump performance is listed in Table 7-3.

TABLE 7-3
JOHNSTON 48 PO PUMP PERFORMANCE
WITH DOWNSTREAM WEIR CONTROL

Pump Design Conditions:	60,000-gpm @ 23.1-ft TDH, 390-RPM; Efficiency – 75%; Power - 457-hp
Pump Capacity @ Basin Elevation 93.5:	58,000-gpm @ 23.6-ft TDH, 390-RPM; Efficiency – 73%; Power – 474-hp
Pump Capacity @ Basin Elevation 93.0:	59,000-gpm @ 23.6-ft TDH, 390-RPM; Efficiency – 74%; Power – 465-hp
Pump Capacity @ Basin Elevation 92.0:	57,000-gpm @ 24.1-ft TDH, 390-RPM; Efficiency – 72%; Power – 482-hp
Pump Operating Speed @ Basin Level 108.0:	80% of Full Speed; 312-RPM
Pump Operating Speed @ Basin Level 111.0:	75% of Full Speed; 293-RPM
Pump Capacity @ Basin Elevation 108.0: *(Full Speed Operation)*	82,000-gpm (183-cfs)

Pump operation is expected to be modulated from full speed (390-RPM) at the pump start level to 80% of full speed (312-RPM) at a Basin elevation of 108.0 to limit pump station output to no more than 400-cfs. A single pump operating at full speed with the Basin elevation at 108.0 feet would discharge approximately 183-cfs of water.

Pump Submergence

Submergence is the depth of water above the pump suction bell. For the Johnston 48 PO pump operating at 390-RPM, the manufacturer recommends a minimum submergence of 140 inches to prevent vortices from forming. Vortexing pulls air and debris into the pump affecting its performance.

It is desirable, however, to lower the required pump submergence as much as possible without impacting performance in order to reduce the depth of the sump structure. This is particularly important when the sump must be built in an area of high groundwater such as at Haster Basin.

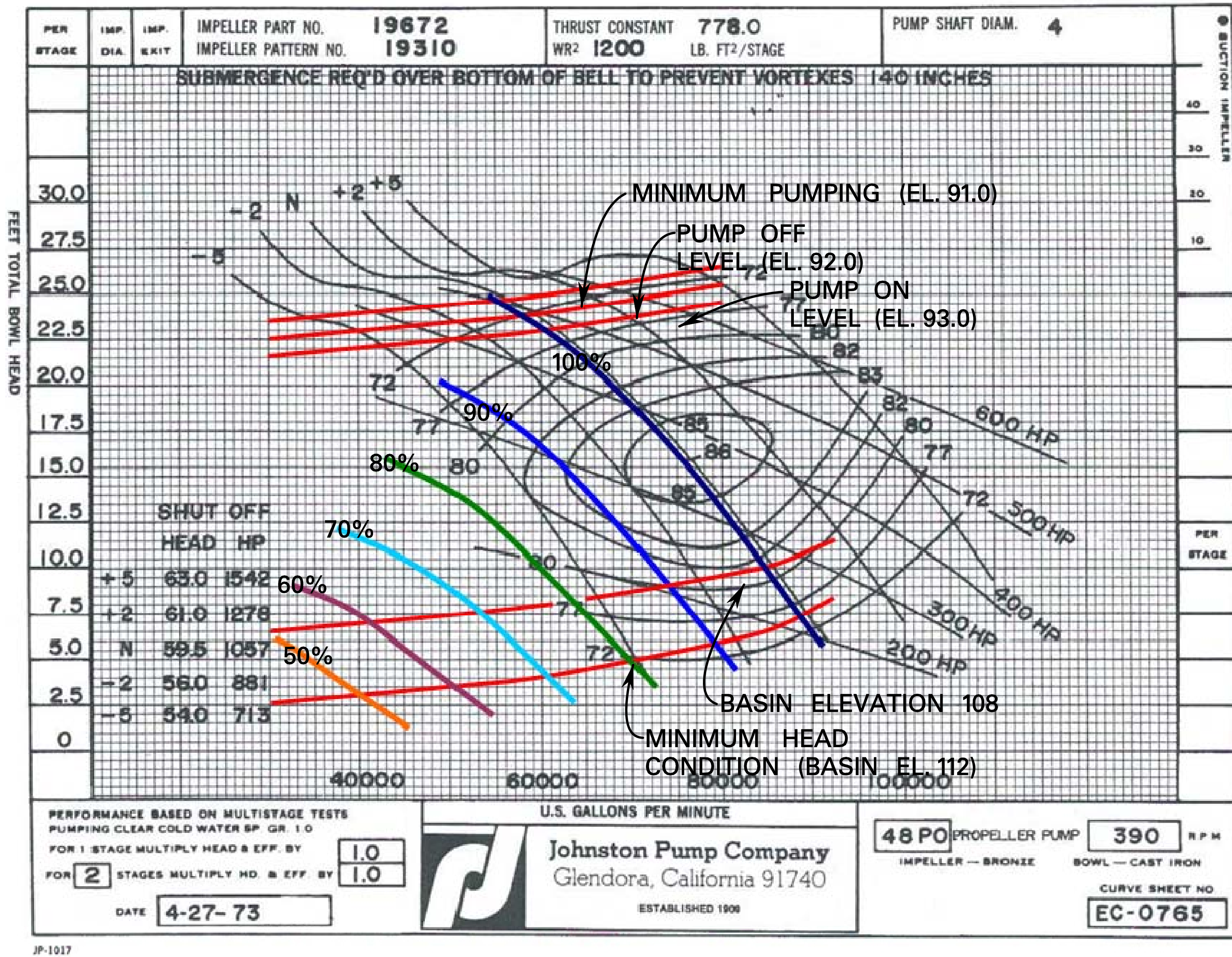

Figure No. 7-2

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

DESIGN CONDITION 60,588 GPM @ 23 FT TDH SEAL WEIR WS EL. 114 FT

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One method for reducing the required pump submergence is through the use of a suction umbrella. Suction umbrellas reduce the inlet velocity to the pump thereby reducing the submergence depth at which vortices are formed.

An ASME publication entitled "Development of an Optimum Sump Design for Propeller and Mixed Flow Pumps" by J.L. Dicmas defines the conditions under which vortices are formed. Figure 7-3 is a plate taken from the Los Angeles County Flood Control District Pump Station Design Manual which provides a chart for determining the required submergence to prevent the formation of vortices. Using a 104-inch diameter suction umbrella would reduce the pump inlet velocity to 2.0-ft/sec. From the chart shown on Figure 7-3, a submergence to pump bell ratio equal to 1.0 will eliminate the formation of vortices. The bell diameter for the Johnston 48 PO pump is 80 inches. Therefore, the minimum submergence required with a 104-inch suction umbrella is also 80 inches.

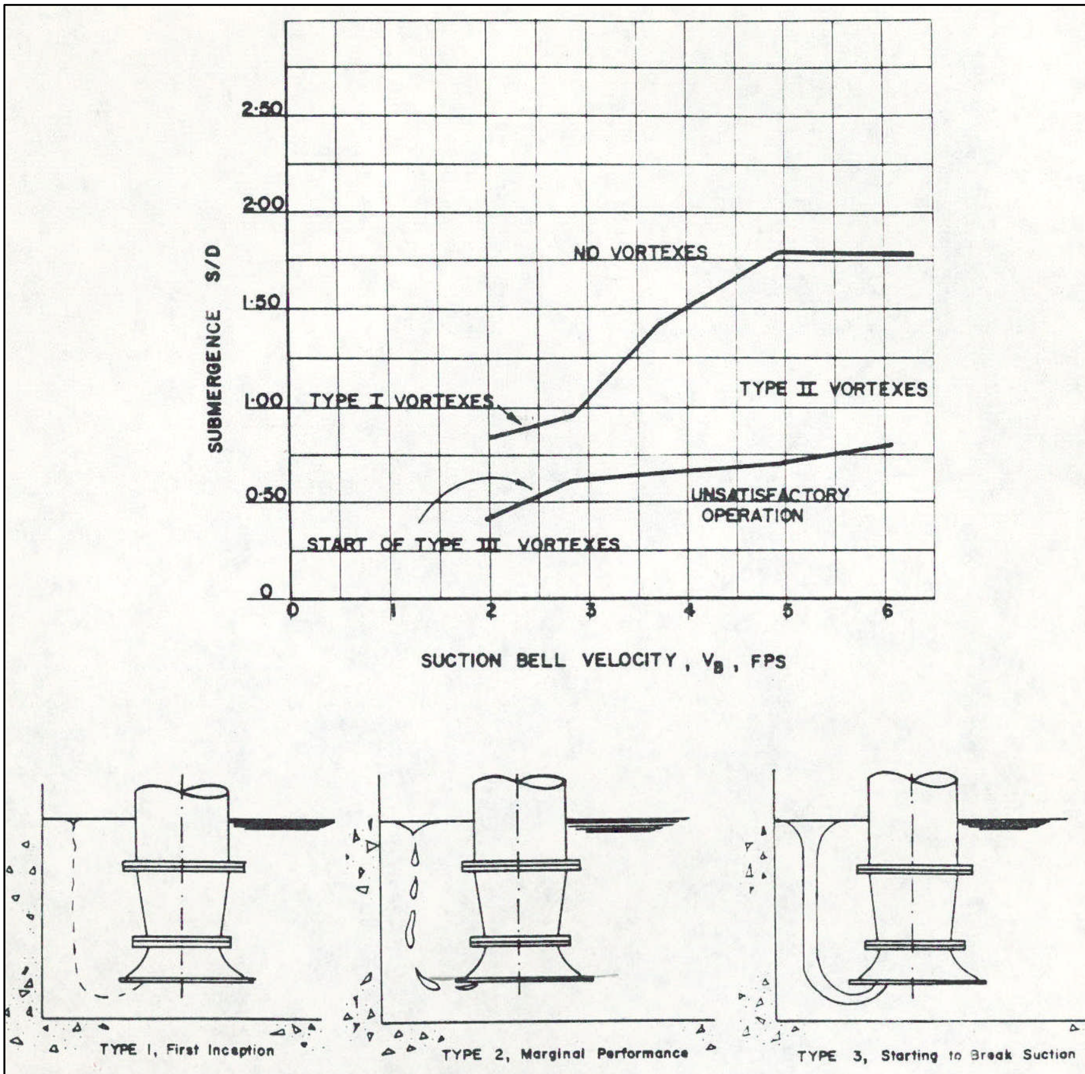


FIGURE 7-3. Vortex Chart

7-2.4 Net Positive Suction Head

Net positive suction head (NPSH) is the absolute pressure of the liquid at the inlet of the pump. It is a function of elevation, temperature and submergence depth. Pump manufacturers typically specify the minimum NPSH required to prevent cavitation, vibration, wear, and useable operation.

The net positive suction head which is available (NPSHA) may be calculated from the following equation:

$$NPSHA = H_{BAR} + H_S - H_{VAP} - H_{ENT}$$

Where: H_{BAR} = Barometric Pressure (33.7 ft)
H_S = Pump Submergence (6.7 ft)
H_{VAP} = Vapor Pressure (0.8 ft)
H_{ENT} = Entrance Losses (0.1 ft)

The net positive suction head available must exceed the net positive suction head required in order for the pump to operate satisfactorily.

The net positive suction head available as calculated from the equation above is 39.5 feet. The net positive head required specified the pump supplier is 30 feet. Therefore the pump should operate satisfactorily.

7-2.5 Pump Downthrust

Downthrust is the force imposed on the pump impeller while operating. This force must be taken up by the thrust bearings in the right angle gear drive, and therefore is important in its sizing. This additional load must also be considered when designing the floor support system for the pump. The pump downthrust can be calculated by multiplying the pumping head by a thrust constant for the pump and adding the weight of the pumps rotating parts. The thrust constant and weight of rotating parts as listed by Johnston pumps is shown below. For design purposes, the maximum pumping head is set at the inflection point of the pump curve, which is 26 feet.

<u>Downthrust for Johnston 48 PO Pump</u>
Thrust Constraint K – 778/lb-ft
Weight of Rotating Parts – 1,250/lb
Down Thrust – 778/lb-ft x 26 ft + 1,250/lb = 21,478/lb

7-2.6 Pump Cycling

To reduce wear and tear on equipment and provide for a long service life, pump cycling should be limited to no more than one (1) start per hour. Maximum pump cycling occurs when the inflow is equal to half the pumping rate.

It is also desirable for a pump and engine to run for a minimum of 20 minutes after it is started. Minimum run times are calculated assuming no inflow of water to the Basin.

Table 7-4 summarizes pump cycling and minimum run times calculated from the Basin capacity curve provided in Section 5, and the required start-stop elevations specified for each pump in the hydraulic analysis, also in Section 5. As shown, there is sufficient volume in the Basin to limit pump cycling to the recommended criteria.

TABLE 7-4
MINIMUM PUMP RUN AND MAXIMUM PUMP CYCLE TIMES

Pumping Conditions	Pumping Rate (cfs)	Start Level	Stop Level	Basin Volume (ft³)	Pump Cycles	Minimum Run Time (minutes)
1. Pump Running	133	93.0	92.0	178,962	1-Start 1.48 hours	22
2. Pumps Running	266	93.5	92.0	357,924	1-Start 1.48 hours	22
3. Pumps Running	400	94.0	92.0	546,096	1-Start 1.52 hours	23

7-2.7 Pump Lube Oil System

The pump shall be furnished with a 1-gallon oil reservoir and solenoid valve for lubrication of the pump shaft. The solenoid valve shall be actuated prior to pump start-up and closed after the pump is shutdown. A bypass valve and piping shall be provided to allow manual oiling of the pump shaft in

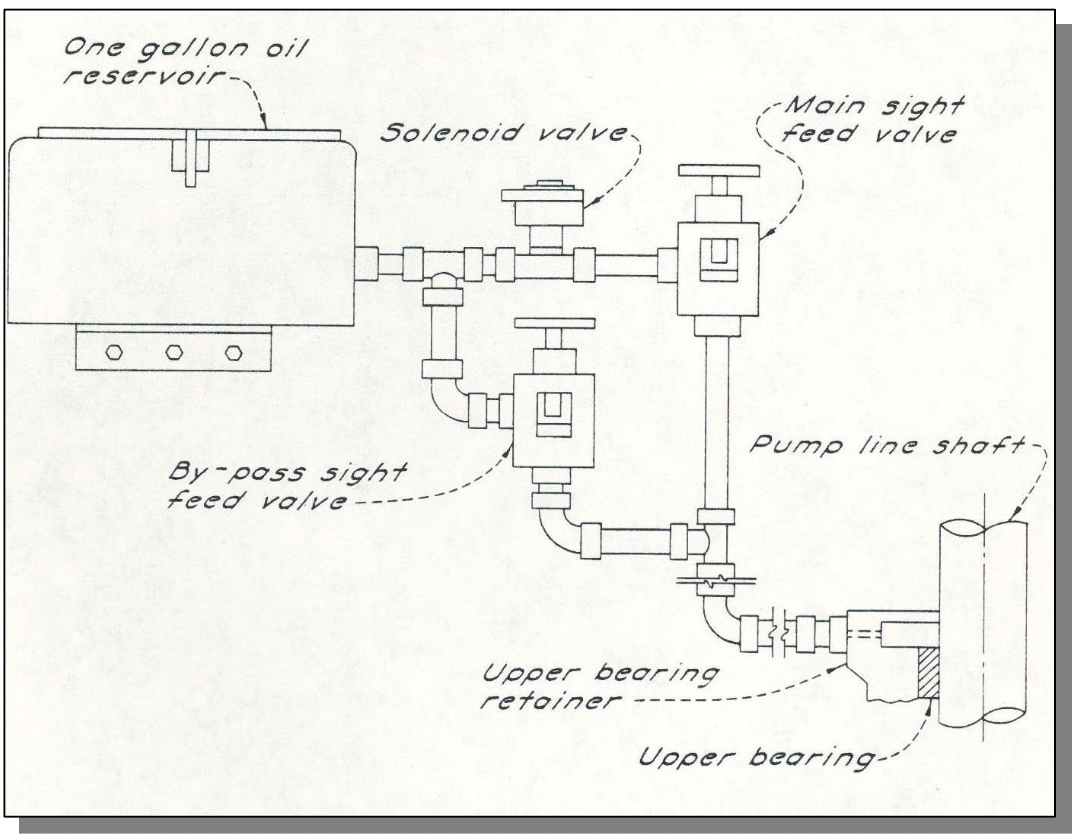


FIGURE 7-4. Recommended Lubrication System

the event of solenoid valve failure. Figure 7-4 shows the recommended lubrication system.

7-3 RIGHT ANGLE GEAR DRIVE

The right angle gear drive is bolted to the top head of the pump and is used to convert the horizontal rotation from the engine drive shaft to vertical rotation of the pump shaft. It must be designed to transmit the entire pumping horsepower, and be able to take up the downthrust generated by the pump. The right angle gear drive also reduces the engine speed (1,200-RPM) to the required pump speed 390-RPM through reduction gearing. Sizing criteria for the right angle gear drive is as follows:

Pump Horsepower:	500
Downthrust:	21,500-lb
Vertical Shaft Speed:	390-RPM
Engine RPM:	1,200-RPM

An Amarillo Gear Company Model P8 right angle gear drive is recommended for the project, with a 3:1 gear reduction ratio. The proposed gear is rated for 605-horsepower (1.21 service factor, and maximum downthrust of 28,700-lbs.)

A gear oil heat exchanger will be required for the unit. The water requirement for the heat exchanger is approximately 5-gpm. A solenoid operated valve will be provided, which will be actuated by the engine control panel prior to the engine being started, and closed after the engine is shutdown. A bypass valve and piping shall be provided to allow water to be manually admitted to the gear oil heat exchanger in the event of a solenoid valve failure. The proposed cooling water

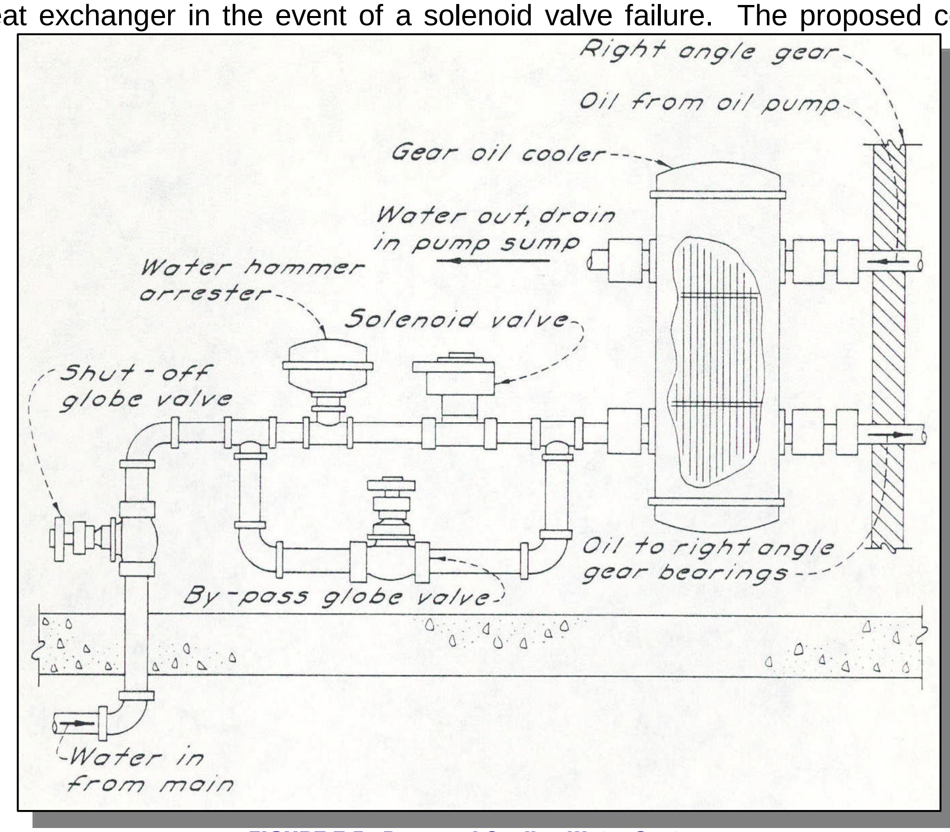


FIGURE 7-5. Proposed Cooling Water System

system is shown on Figure 7-5.

The right angle gear drive shall also be specified with the following devices and instrumentation.

- Non-Reverse Ratchet
- High Oil Temperature Switch Gauge
- High/Low Oil Level Switch Gauge
- Tachometer

All instrumentation will be connected to the engine control panel located in the pump station office. A high oil temperature signal will cause the pump to be shutdown. High/low oil level will only signal the condition for servicing by maintenance personnel.

7-4 NATURAL GAS ENGINES

7-4.1 Criteria

The prime mover for each pump will be a natural gas engine. Criteria for engine sizing and selection are as follows:

- Type – Heavy duty, natural aspirated, industrial
- Speed – 1,200-RPM Maximum
- Maximum Horsepower – Loaded below 70% of the maximum brake horsepower available
- Fuel – Natural gas with LPG back-up system
- Cooling – Sump mounted heat exchanger and City water cooled auxiliary heat exchanger

7-4.2 Selection

- Horsepower – Pump horsepower required is 500. Losses through the right angle gear drive are assumed to be 5% of the pump horsepower (25). The required engine horsepower rating is 525-hp divided by the maximum loading of 70%, which is 750-hp. The 70% loading is to account for an increase in horsepower that may be caused from pumping debris or pump wear.
- Brake Mean Effective Pressure (BMEP) – BMEP is an empirical measure of the load imposed on an engine. It is represented by the following equation. Solving this equation for displacement results in 4,620-in^3 engine as a minimum being required.

$$BMEP = \frac{792{,}000 * hp}{RPM * Displacement}$$

Based upon the criteria above, a Waukesha L5790G naturally aspirated engine is recommended. It meets all project requirements and is the same equipment recently installed by the County at its Rossmoor Pumping Station. Specifications for the engine are presented in Table 7-5. A picture of the engine installed at the Rossmoor Stormwater Pump Station is shown in Photograph 7-1.

PHOTO 7-1. Waukesha L5790G Natural Gas Engine

TABLE 7-5
WAUKESHA L5790G Natural Gas Engine Specifications

Cylinders:	V12			
Displacement:	5,790-in^3			
Aspiration:	Natural			
Compression Ratio:	8.2:1			
Dry Weight:	20,500			
Power Rating (Continuous):	700-RPM 490-hp	800-RPM 554-hp	900-RPM 613-hp	1,000-RPM 667-hp
	1,100-rpm 714-hp	1,200-rpm 750-hp		
Natural Gas Pressure Required at Regulator:	5-7-psi			
Fuel Consumption (max):	4.6-MBTU/hr			
Maximum Exhaust System Back Pressure:	18-Inch W.C.			
Dimensions:	144-inch (L) x 100-inch (W) x 94-inch (H)			

7-4-3 Cooling System

The engine cooling system is shown on Figure 7-6. It consists of a sump mounted engine jacket water heat exchanger installed in series with an auxiliary jacket water heat exchanger cooled with City water. The engine water pump pumps coolant through the engine thermostat to the sump mounted heat exchanger. The sump mounted heat exchanger uses stormwater moving through the unit to cool the engine jacket water. The heat exchanger is designed to reduce the coolant temperature to 189°F.

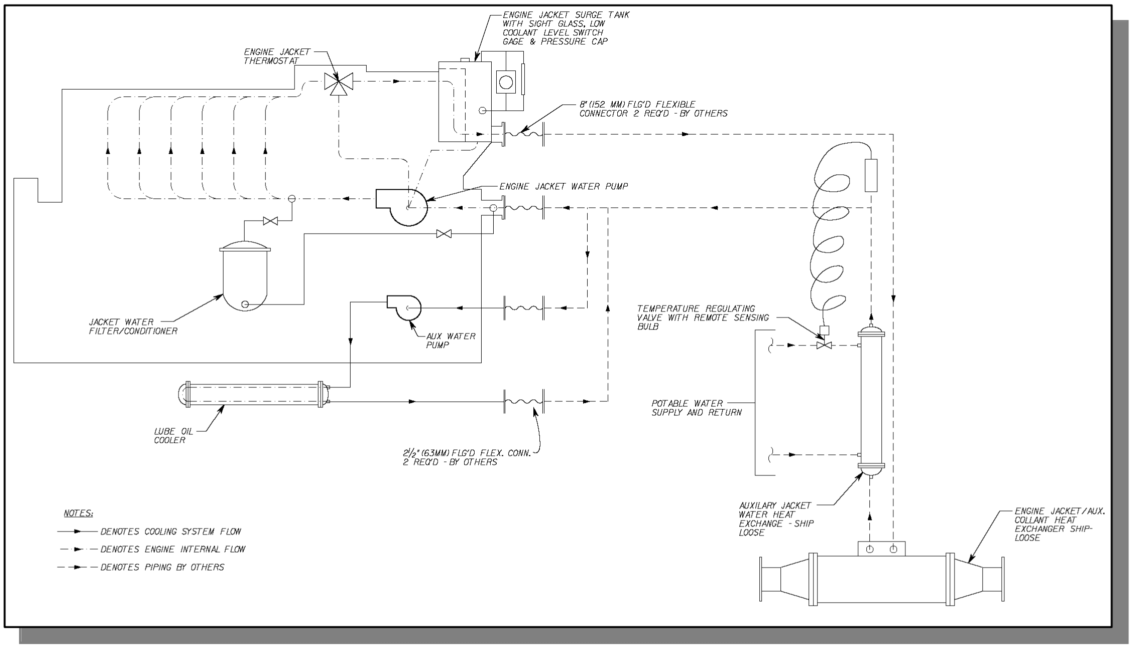


FIGURE 7-6. Engine Cooling System

In series with this unit is an auxiliary heat exchanger which uses City water to provide additional cooling of the engine jacket water if the inlet temperature is above 190°F. This auxiliary unit could also be used as the primary engine cooling element if there is no water in the sump. The auxiliary heat exchanger requires 100-GPM of water to operate. A temperature actuated modulating value is used to control water flow through the heat exchanger based upon coolant temperature. Spent water from this system is discharged to the sump.

7-4.4 Engine Jacket Heater

A jacket water heater will be supplied with the engine to ensure that it stays warm and starts in cold weather. A 2,500-watt heater is required that operates on 240-volt single phase voltage.

7-4.5 Engine Lube Oil System

Figure 7-7 is a diagram of the engine lube oil system. All components are mounted on the engine with the exception of the lube oil filter which is mounted separately. The pre-lube pump is electric motor driven and is started prior to the engine being called, to pre-lubricate engine parts, as it is likely the engine has not been operated for a long period of time. After a predetermined period, the pre-lube pump is stopped, the engine started, and the engine driven lube oil pump is used to circulate oil through the engine. The system includes a heat exchanger with a temperature control valve to cool the oil system. Engine jacket water is circulated through the lube oil cooler for this purpose.

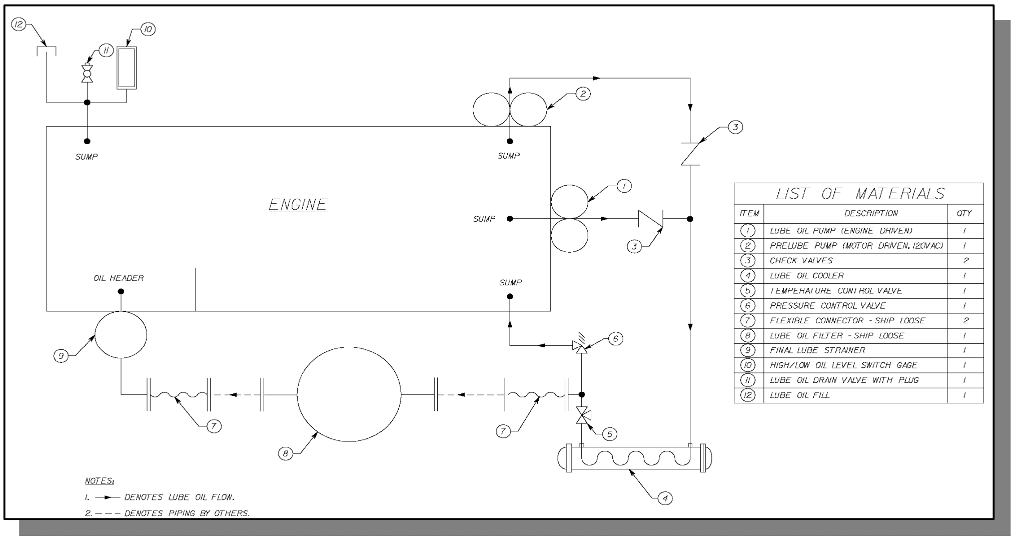


FIGURE 7-7. Diagram of the Engine Lube Oil System

7-4.6 Instrumentation

The engine will be specified with connections for the following instruments:

- High/Low Oil Level Switch Gauge (Murphy L129)
- Vibration Switch (Murphy VS2)
- Engine Throttle Controller (Murphy AT-67207
- Tachometer Magnetic Pick-Up (Murphy MP3298)
- Oil Pressure Switch Gauge (Murphy A20-P-HL)
- Engine Vacuum Switch Gauge (Murphy A20-B-VG)
- Coolant Temperature Switch Gauge (Murphy A-20-G-TG)
- Coolant Level Switch Gauge (Murphy EL-150 EX)

All gauges will be located in the engine control panel to be installed in the pump station office.

7-4.7 Power Take-Off (PTO) Clutch

Each engine will be equipped with a PTO clutch. The clutch allows the operator to manually disengage the engine from the pump during exercising, testing, and servicing of the engine. The clutch is bolted directly to the engine flywheel housing and is connected to the right angle gear drive by a flexible drive shaft. A limit switch will be installed on the clutch to signal an alarm if the clutch is inadvertently left in the disengaged position. A Twin Disc Model SP-321-P-00 PTO clutch is recommended for the project.

7-4.8 Batteries and Charging System

The battery system shall include two 12-volt, group 8D commercial, heavy duty batteries connected in series to produce 24-volts of power. The batteries will be installed in a battery rack located next to the engine.

A remote mounted solid state battery charger, rated for 7-amps at 24-volts DC, will be supplied for each engine. A Stored Energy Systems (SENS) Model NRG 24-7-RCLS is recommended for the project.

The engine will also be equipped with an alternator to charge the engine batteries during engine operation.

7-4.9 Engine Exhaust System

The exhaust system piping will be Schedule 40 steel and will be sized to limit back pressure at the engine to no more than 10 inches of water. To convey the manufacturer specified exhaust rate, a 7-inch exhaust pipe is required. The piping will be designed to slope away from the engine into a drip leg to prevent condensation from running back into the engine causing damage. Exhaust piping will be connected to the engine using a stainless steel flexible fitting. Where the piping penetrates the roof, a thimble will be provided. A rain cap will be installed on the outlet of the exhaust pipe to prevent rain from accumulating in the piping.

The exhaust system will be equipped with a super critical grade exhaust silencer. The silencer will be constructed of stainless steel and will have a sound attenuation of 33-40 dBA. The recommended exhaust silencer is a GT exhaust system; Model 201-6100 Series, super critical grade.

Also installed in the exhaust piping is a catalytic converter designed to reduce gas emissions to levels required by the South Coast Air Quality Management District. An oxygen sensor and thermo couples installed on the inlet and outlet of the catalytic converter will be connected to an air fuel ratio controller also supplied with the engine.

All of the exhaust system components will be wrapped with 6 inches of calcium silicate insulation, enclosed by an aluminum housing. The calcium silicate insulation will be rated for 1,200°F, and will reduce the surface temperature at the exterior of the insulation to 130ºF maximum.

The catalytic converter and exhaust piping will be supported directly above the engine by a steel support frame. Figure 7-8 shows the proposed engine exhaust system.

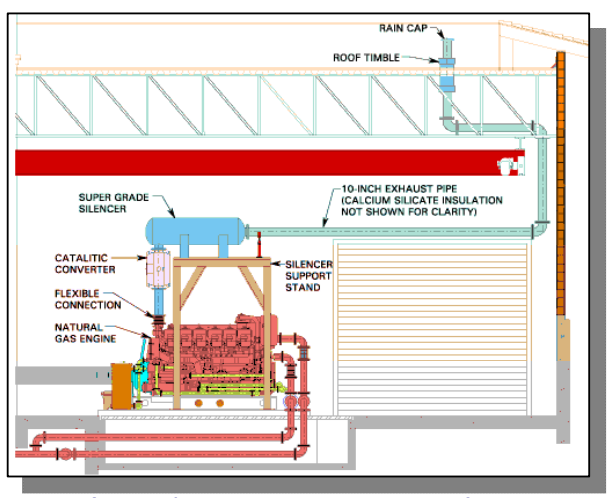


FIGURE 7-8. Proposed Engine Exhaust System

7-4.10 Fuel System

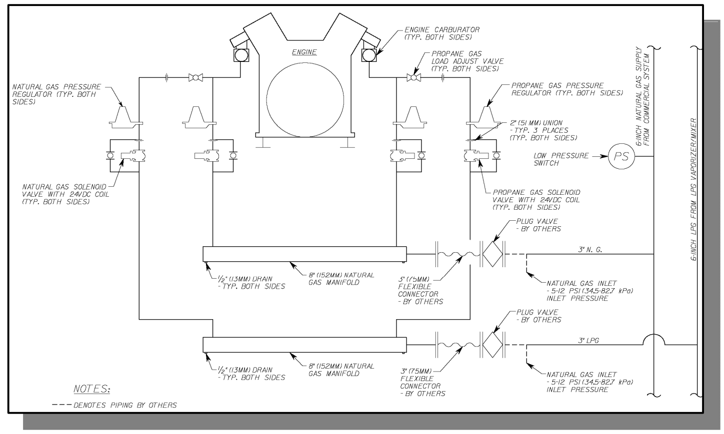


FIGURE 7-9. Diagram of the Proposed Fuel System

The engines will primarily operate on natural gas supplied through a connection with Southern California Gas. However, a LPG fuel system will be designed into the project as an emergency back-up fuel system in the event the commercial natural gas system fails. Figure 7-9 diagramically shows the proposed fuel system. The natural gas piping system will be designed as a 6-inch Schedule 40 steel manifold from the SCG meter into the pump station engine room. A 3-inch steel pipe will be extended from the 6-inch manifold to each engine. A solenoid valve and regulator will be installed on each line feeding the engine carburetors. A bypass valve will be installed parallel to each solenoid valve to allow an operator to manually feed gas to the engine should the solenoid fail.

A low pressure switch will be installed on the 6-inch natural gas manifold to detect a loss in commercial gas service pressure. Once activated, the pressure switch will send a signal to the central control panel alarming the natural gas system failure. The central control panel will then tell each engine control panel to switch over to the LPG fuel system.

7-4.11 LPG Back-Up Fuel System

The engines will be equipped with regulators, a fuel transfer switch, and carburetion suitable for LPG or natural gas service. Natural gas will be the primary fuel source. LPG will be used as a back-up system.

A vaporizer-mixer and propane storage tanks sized for a minimum 12-hour fuel supply will be provided. The design will be in accord with the most current LPG code (NFPA 58). The vaporizer-mixer will be sized as recommended by the engine manufacturer. These units may incorporate electrically powered heating elements or utilize the engine cooling system as a heat source. Components provided with each LPG storage tank will include:

A. Filling Level Indicator

B. Filler Valve for transferring of fuel between the truck and tank

C. Vapor Equalization Valve is used in conjunction with filler valve to expedite the transfer of the fuel

D. Pressure Relief Valve is used to release excessive tank pressure

E. Excess Flow Valve which prevents flow in the event of a line break

F. Liquid Level Gauge

G. Filling Level Indicator to allow for liquid expansion and comply with the National Bureau of Fire Underwriters Code requirements

For a minimum 12-hour backup supply of fuel, two 2,000 gallon tanks are recommended. Both tanks are estimated to be 4'6" Ø x 18'6" L. Other options are provided in the chart below.

Horsepower	Btu/BHP*Hr	Time (hrs)	Fuel (Btu) 1 Engine	Fuel (Btu) 3 Engines	Fuel (gallons)	Tank 80% Full	Tank Recommended	Tank Size
820	7900	12	77,736,000	233,208,000	2534.87	3168.59	2 - 2000 gallon tanks	54" x 221"
820	7900	10	64,780,000	194,340,000	2112.39	2640.49	2 - 1600 gallon tanks	54" x 174"
820	7900	8	51,824,000	155,472,000	1689.91	2112.39	2 - 1230 gallon tanks	42" x 218"
820	7900	6	38,868,000	116,604,000	1267.43	1584.29	1 - 2000 gallon tank	54" x 221"

In accordance with the LPG code, tanks must be located a minimum of 25 feet from the pump station building and be separated a minimum of 3 feet. The propane tanks will be located outside, in parallel, on a concrete pad and enclosed with an 8-foot high steel picket fence. A swing gate will provide access to the tanks. A curb will be provided to surround the area which will contain an LPG spill from flowing into the Basin.

LPG is a liquid that must be transformed to vapor by the addition of heat before it can be used by the engine carburetor. LPG vapor is not directly compatible with natural gas and must be mixed with air before it can be used in equipment and appliances that are set up for natural gas. Vaporizer-mixer systems consist of a vaporizer that converts LPG liquid to LPG vapor and a vapor/air mixer that mixes air and vapor to produce a gas mixture compatible with natural gas. This allows the gas engines to run on either natural gas or LP Gas without changing setups. The vaporizer-mixer recommended for this project will be Ransome Manufacturing PAM400-20 Direct-Fired LP-Gas Vaporizer/Air Mixer.

In addition to the vaporizer-mixer, a surge tank will be needed to monitor the system's gas pressure and adjust any sudden changes in pressure. A schematic diagram of the proposed LPG system is shown on Figure 7-10.

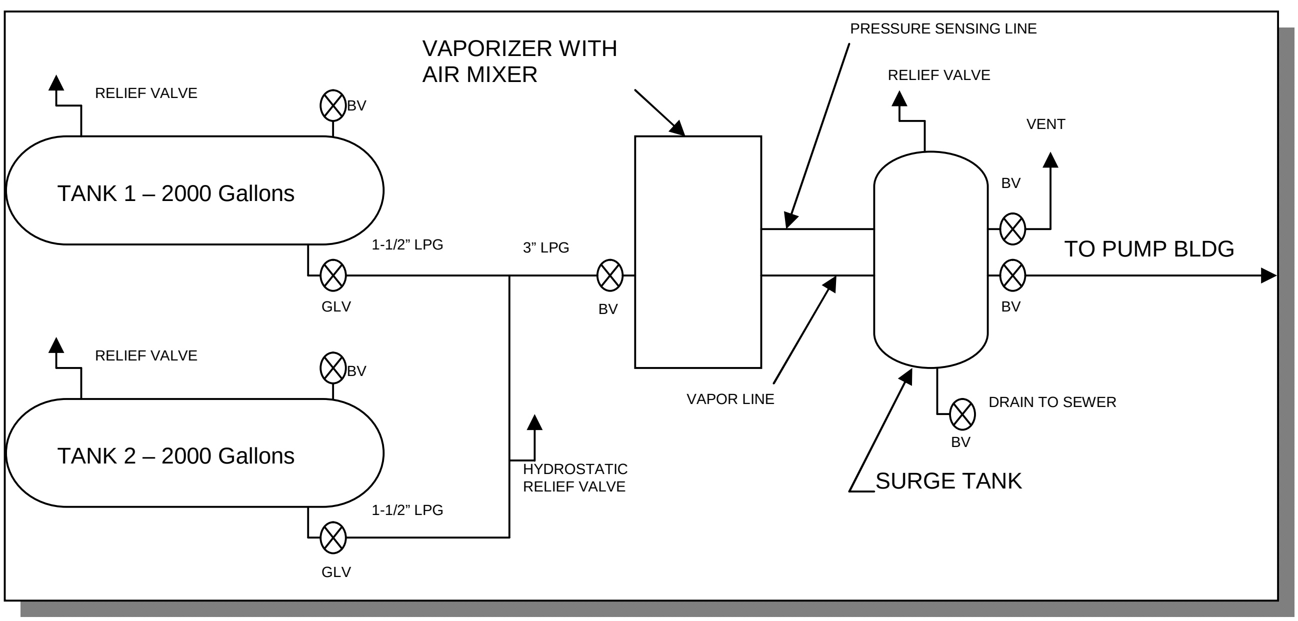


FIGURE 7-10. Propane Fuel System Schematic

7-5 SUMP PUMPS

The sump pump is used to empty the pump station sump at the end of a storm and to pump low flows generated from dry weather urban runoff and low level precipitation events. The sump pump would also be used to drain the Basin of all water, if required.

Two pumps are proposed. A 500-gpm (1.1-cfs) capacity pump would be used to pump dry weather urban runoff collected by the Basin. This flow is estimated to be 300-gpm from County furnished flow records. A 3,000-gpm (6.7-cfs) pump would also be provided to operate during major rain events and to drain the Basin. Both pumps would be located in a 6-foot wide by 6-foot long by 7-foot deep pit placed below the pump station sump floor. The smaller pump would be staged to start at the level of the floor (elevation 82.0 feet), and turn off at elevation 78.0 feet, which is 3 feet above the sump pit bottom. The larger sump pump would be started at elevation 83.0 feet. Once started, the smaller pump would be locked out from operating. The 3,000-gpm sump pump would then operate until the water level in the sump is lowered to elevation 75.0, or the level at which the main pumps are called to start (elevation 93.0 feet). Once the main pumps are started, the larger sump pump would shutdown. When the main pumps have lowered the sump to the pumps preset stop level (elevation 92.0 feet), the main pump is stopped and the large sump pump is restarted.

The county has requested that both pumps be recessed impeller type pumps. The larger will be a WEMCO 10x8x17L and the smaller will be a WEMCO 6x11M

Recessed Impeller Pumps

The impeller on a recessed impeller pump is located completely out of the flow path; therefore, the pump's solids handling capacity is only limited by the size of the suction and discharge nozzle. Liquid is pumped by a strong vortex created by the rotating impeller. These pumps provide good solids handling capability, but have very low efficiencies (25 to 50 percent). They require significantly more power to operate due to their low efficiencies. Figure 7-11 illustrates the construction of a recessed impeller sewage pump.

FIGURE 7-11. Disassembled Recessed Impeller Sewage Pump

Both pumps will be specified with a stainless steel impeller to provide improved resistance against abrasion. A stainless steel wear plate will also be specified to protect the lower mechanical seal.

It is recommended that in addition to the sump pumps being installed, a spare pump and motor of each size be purchased as part of the construction contract. The sump pumps will be installed on slide rails so that they can be removed for servicing without entering the sump or disassembling the piping.

To prevent sediment from solidifying in the sump pit, a sump agitation system will be provided. The sump agitation system uses water pressure to break up material accumulated in the sump pit so that it may be pumped out. The system includes a ring of PVC pipe and nozzles installed along the interior wall of the sump pit near the bottom. The system will be solenoid controlled so that it can be automatically activated by the pump station central controller. It will also include a bypass valve so that the system may be manually initiated by an operator.

7-6 SUMP DESIGN

Good sump design is critical to achieving optimum performance of the pumping equipment. Conditions which have a negative impact on pump operations include:

- Submerged and free surface vortices
- Pre-Swirl of flow entering the pump
- Entrained air or gas bubbles

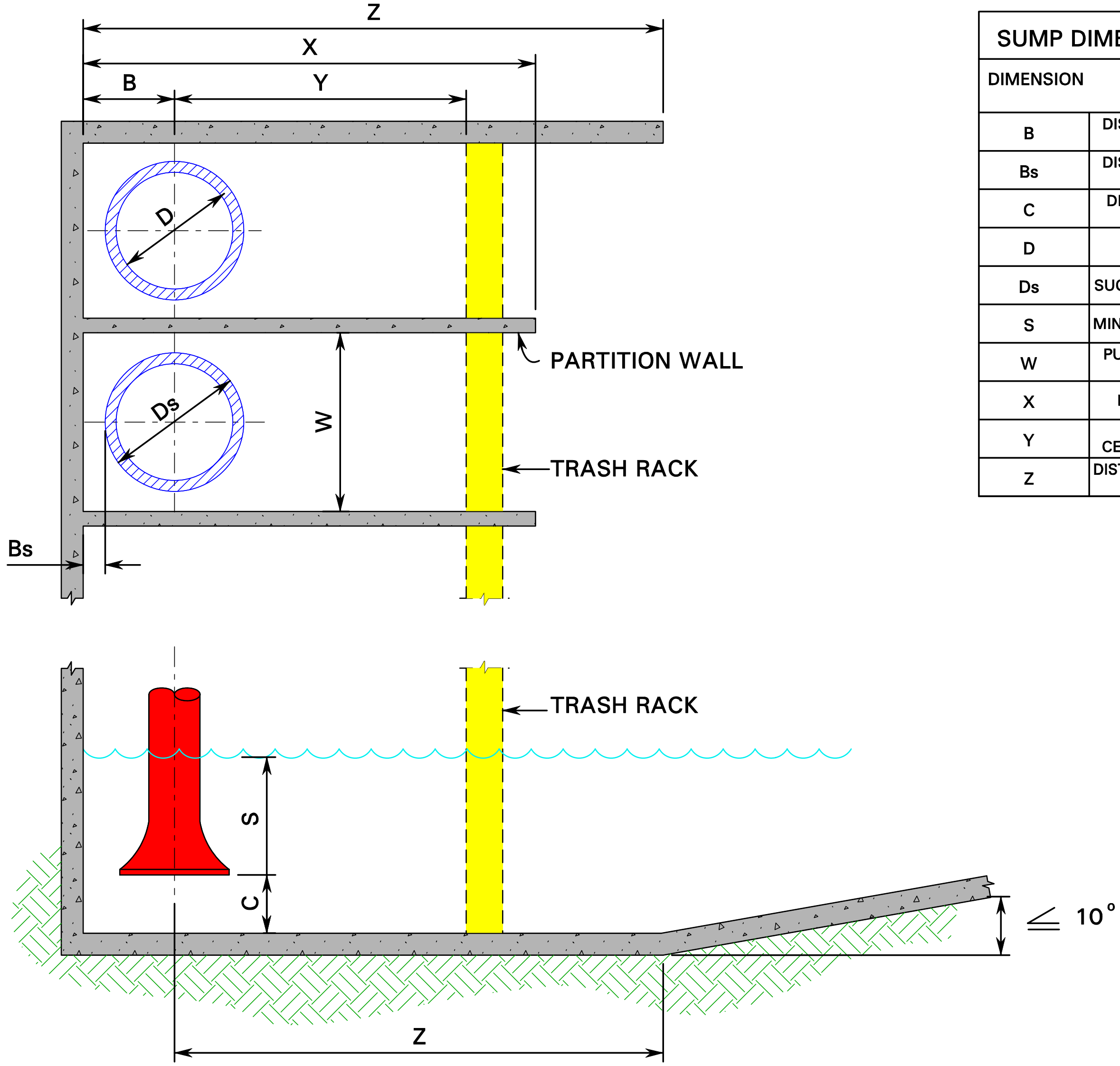
To minimize the impact of adverse flow phenomena, the sump structure will be designed in accordance with the criteria established by the Hydraulic Institute of Standards. These standards seek to optimize the approach flow pattern so that cross-flows or asymmetric flow patterns in the vicinity of the pump are minimized or eliminated. In general, the standards give dimensional recommendations to provide the following:

1. Adequate depth of flow to reduce velocities and the potential for the formation of vortices.
2. Pump bay widths designed to limit the approach velocities to each pump to no more than 1.5 ft/sec.
3. Long channels in front of the pumps to promote uniform flow distribution.

Sump dimensions, as recommended by the Hydraulic Institute of Standards, are shown on Figure 7-12. Based upon this standard, the following minimum dimensions are required for the Haster Basin sump. All dimensions are based upon the recommended pump selection which has a suction bell diameter "D", equal to 80 inches; and a suction umbrella diameter, "D_S", equal to 104 inches as previously identified in Section 7-2.3 of this report (see Table 7-6).

TABLE 7-6
RECOMMENDED SUMP DIMENSIONS FOR THE HASTER BASIN PUMP STATION

B	Distance from back wall to pump centerline	5'-0"
B_s	Distance from back wall to Suction umbrella	8"
C	Distance from inlet bell to floor	≤ 2'-0"
W	Pump bay width	≥ 13'-4"
X	Pump bay length	≥ 33'-4"
Y	Distance from pump centerline to trash rack	≥ 26'-8"
Z	Distance from centerline of pump to sloping floor	≥ 33'-4"



SUMP PUMP SECTION

SUMP DIMENSION REQUIREMENTS TABLE		
DIMENSION	DESCRIPTION	RECOMENDED VALUE
B	DISTANCE FROM BACK WALL TO PUMP CENTERLINE	0.75D
Bs	DISTANCE FROM BACK WALL TO SUCTION UMBRELLA	0.10D
C	DISTANCE FROM INLET BELL TO FLOOR	$0.3D \leq C \leq 0.5D$
D	INLET BELL DIAMETER	
Ds	SUCTION UMBRELLA DIAMETER	
S	MINIMUM PUMP SUBMERGENCE	
W	PUMP INLET BAY ENTRANCE WIDTH	2D
X	PUMP INLET BAY LENGTH	$\geq$ 5D
Y	DISTANCE FROM PUMP CENTERLINE TO TRASH RACK	$\geq$ 4D
Z	DISTANCE FROM CENTERLINE OF PUMP TO SLOPING FLOOR	$\geq$ 5D

Figure No. 7-12

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

SUMP DESIGNS FROM HYDRAULIC INSTITUTE OF STANDARDS

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The proposed sump layout for the Haster Basin Pump Station is shown on Figure 7-13. Its overall length including the apron is 106 feet and the width is 64'-8". The sump incorporates 5 bays. Three 13'-4" wide pump bays, one 6-foot wide sump pump bay, and a stairwell leading from the pump room to the sump. There is a 6-foot wide maintenance platform provided at the level of the pump discharge pipes. From this platform, the operator can access the pump flexible coupling and inspect or wash down the sump without the need to go to the bottom. Access to this platform area is by stair or via a ladder through a hatch in the pump room floor slab. The stairway to the sump floor would be constructed of aluminum, and would incorporate landings every 12 feet in height. The bottom of the sump is at approximate elevation 82 feet, but slopes to the sump pit. The floor is designed to slope upward at an angle of 7-degrees, approximately 3 feet past the end of the partition walls, until it reaches an elevation of approximately 90 feet where the sump ends.

7-7 TRASH RACK

A trash rack is provided to protect the pumps from large trash and debris. It also prevents trash from being pumped downstream to the receiving waters in Bolsa Chica Bay. The trash rack will be constructed of stainless steel grating and stainless steel supports. The rack will extend the entire height of the sump and will be constructed at an angle of 30-degrees to provide increased surface area.

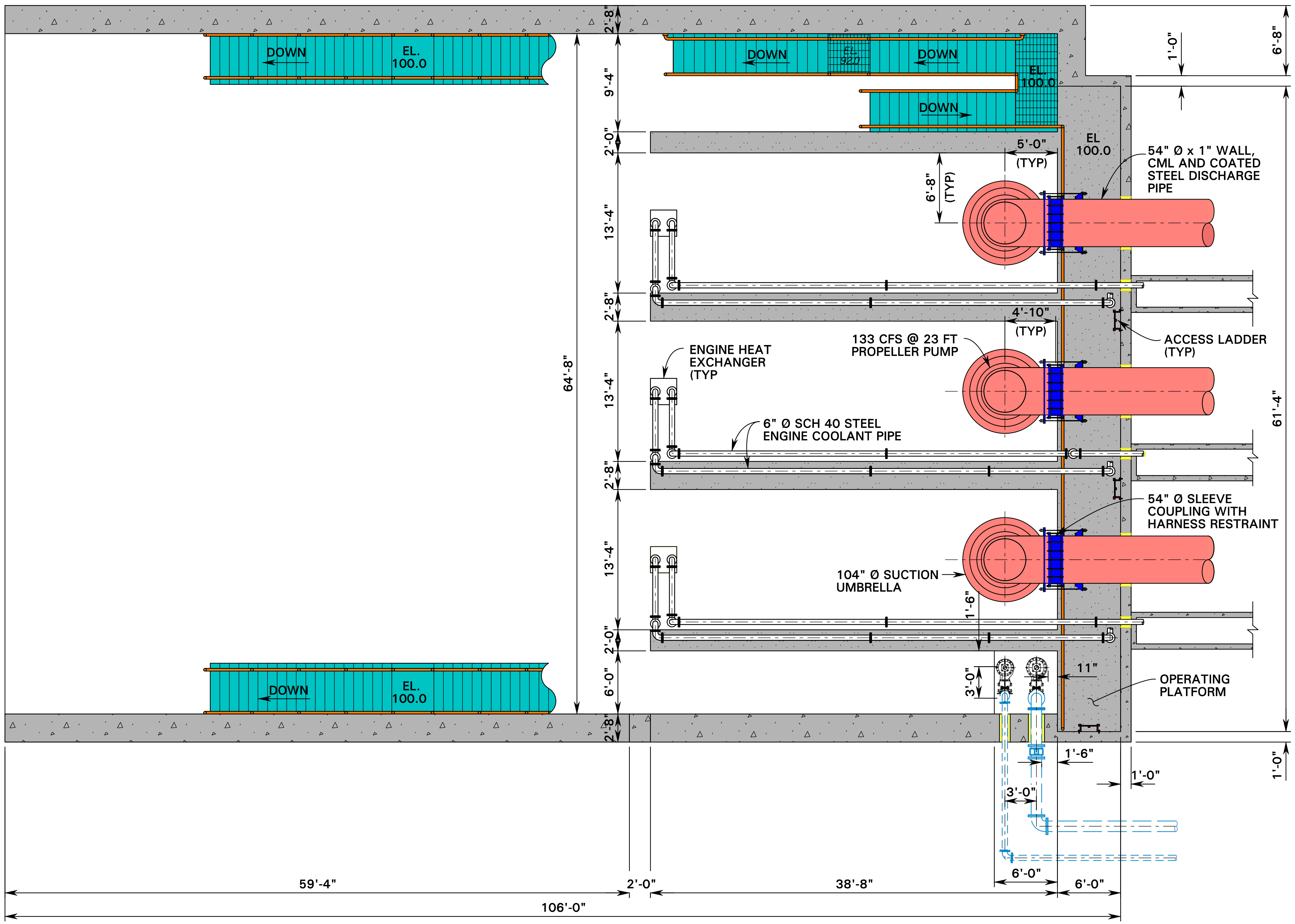
As directed by the County, the trash rack shall be similar in design as the trash racks at Los Alamitos and Rossmoor Pump Stations. This trash rack will feature openings of 4 inches by 15 inches uniformly throughout its surface.

7-8 PUMP STATION LAYOUT

The pump station building layout is shown on Figure 7-14, 7-15 and 7-16. Overall dimensions for the building are 71'-4"(W) by 68'-0"(L) by 38'-2"(H). It includes an engine room, office, restroom, and stairwell. If the bridge crane and walk-out roof access are eliminated from the design, the building height could be reduced to 25'-3". The building layout is described below.

7-8.1 Engine Room

The engine room layout includes a minimum of 6 feet clear distance between adjacent equipment and the walls to allow for equipment disassembly and maintenance. A 15'-4" wide drive aisle is provided to allow for the engines to be removed by flatbed truck. This area can be reduced to 8 feet if a roof hatch is provided for engine removal by crane. Hatches will be provided in the floor of the engine room to allow removal of the sump pump and trash bins (used during sump cleaning) by the bridge crane. Approximate dimensions of the engine room are 53'-4"(W) by 63'-4"(L) by 21'-6"(H).



SUMP PLAN

SCALE: $\frac{3}{32}$" = 1'-0"

Figure No. 7-13

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SUMP PLAN

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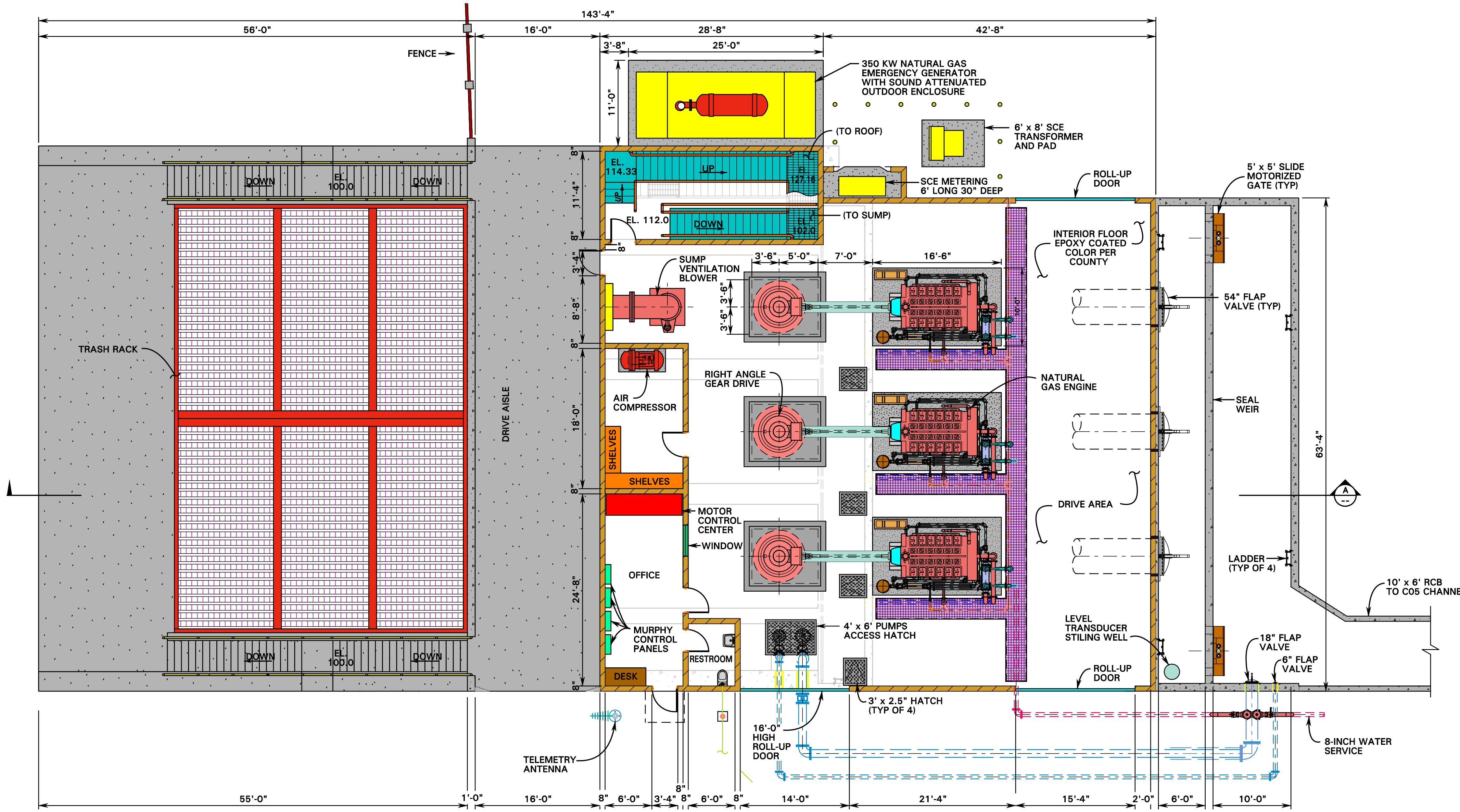

PUMP STATION FLOOR PLAN
SCALE: $\frac{1}{16}$" = 1'-0"

Figure No. 7-14

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PUMP STATION FLOOR PLAN

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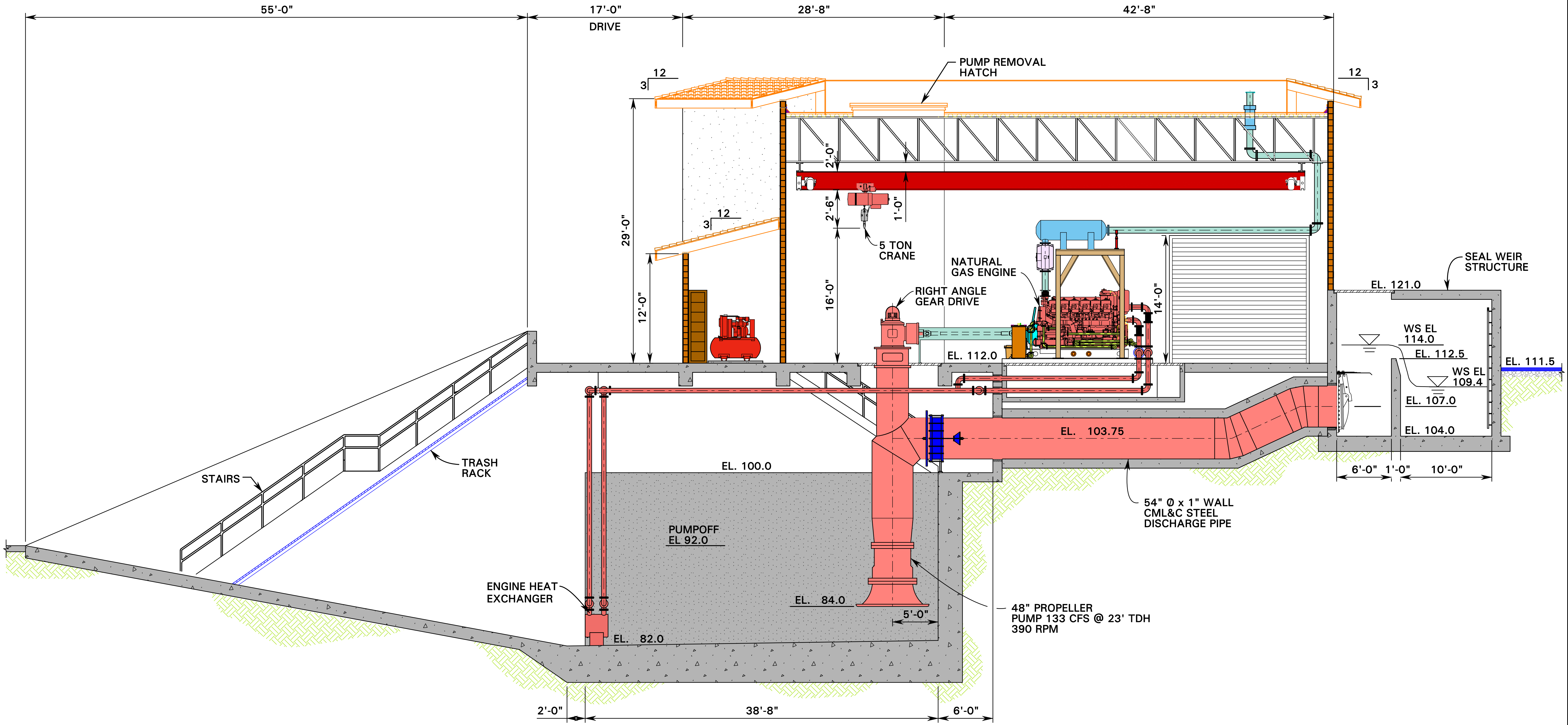

PUMP STATION SECTION

SCALE: 3/32" = 1'-0"

Figure No. 7-15

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PUMP STATION SECTION

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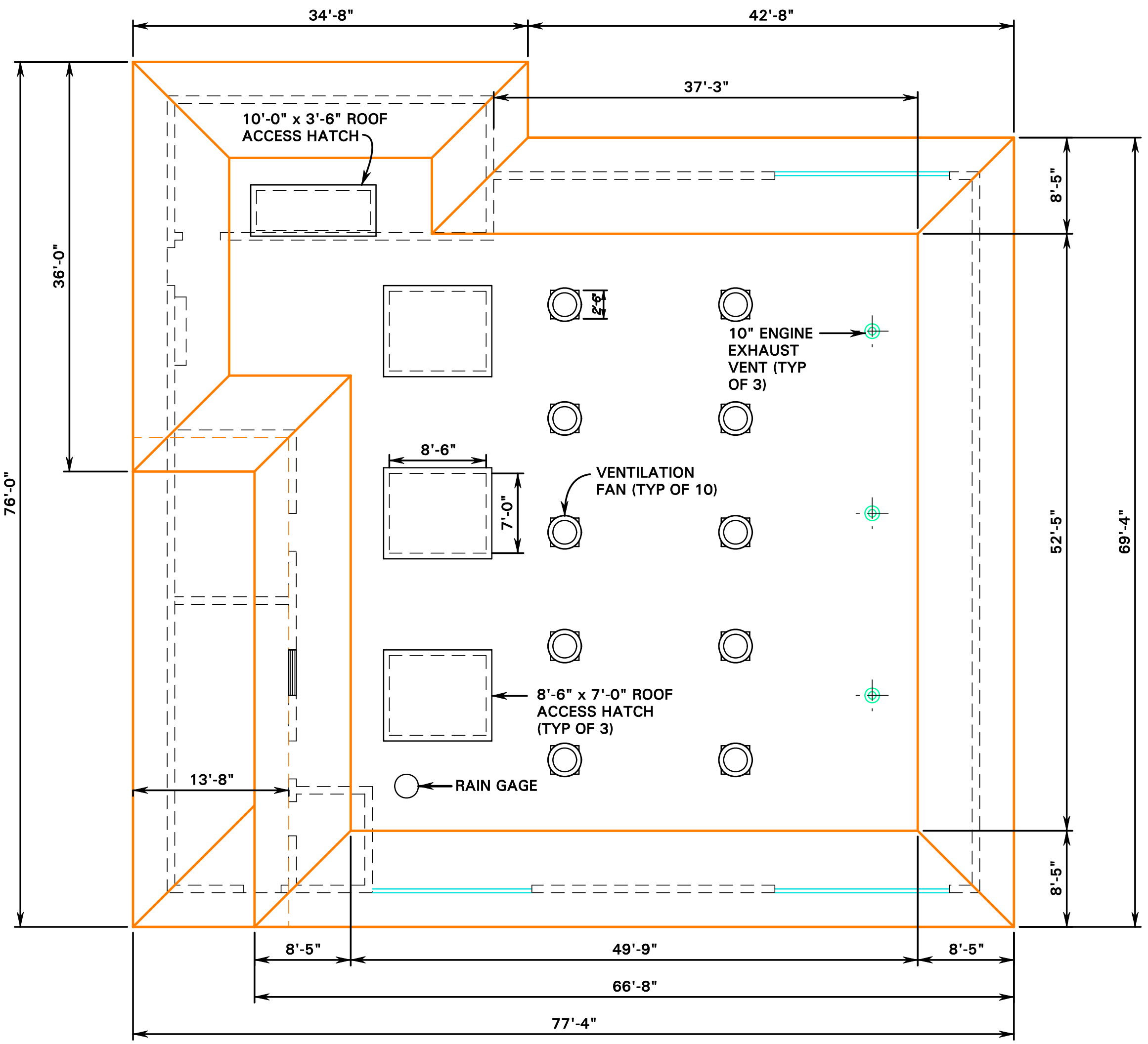

ROOF PLAN

Figure No. 7-16

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

ROOF PLAN

7-8.2 Office

An office has been provided for personnel to monitor the pumping station during operation. The area will be heated and cooled by a small ½-ton heat pump. The central pump station control panel and engine control panels will be located in the office for operator convenience. A telephone and desk will also be provided in the office. The electrical switchgear for the pump station is located in this room. There is a window to the engine room for visually monitoring the engines. Approximate dimensions of the office are 24'-8"(L) by 10'-0"(W) by 10'-0"(H)

7-8.3 Restroom

An ADA compliant restroom is provided at the facility. It includes a lavatory and water closet. Sewer service will be provided from a City of Garden Grove 8-inch sewer in Aspenwood Lane. Approximate dimensions of the restroom are 8'-0"(W) by 6'-0"(L) by 10'-0"(H).

7-8.4 Stairwell

The stairwell provides access to the sump floor and roof. Stairs will be aluminum or stainless steel. Approximate dimensions of the stairwell are 11'-4"(W) by 27'-4"(L).

7-9 ARCHITECTURE

The pump station will be located in a park setting, adjacent to a residential community. The architectural design must be compatible with both settings while still maintaining the necessary functionality required for a pumping station. A Spanish style building was ultimately chosen as the architectural theme. This architectural style embodies Southern California, and is commonly found in parks and residential areas. The building materials used in the construction of these types of buildings are also rugged, require little maintenance, and are well suited for a public works facility.

Figure 7-17 is a colored rendering depicting the west elevation of the proposed building. The walls of the building are concrete block with a ⅞-inch sand stucco exterior finish. Foam trim with a precast finish would be provided at various wall locations to simulate windows, and provide relief in areas which otherwise would be blank. Louvers installed for ventilation purposes would be disguised to look like shuttered windows. Doors would be metal with wood cladding and would include an awning matching the roof design. The roof would consist of concrete Spanish tile, laid over plywood sheathing supported by wood rafters with shaped tails at the eaves. The slope of the roof would be 4"V:12"H. Miscellaneous architectural features would include lantern style exterior lights, skirt boards at building mid-height, and a water feature.

Elevations of all four building sides are provided in the 11" by 17" drawings contained at the end of this section. The architectural concept and elevations were developed by Knitter and Associates as a subconsultant to AKM.

HASTER RETARDING BASIN PUMP STATION

COUNTY OF ORANGE

GARDEN GROVE, CALIFORNIA

KAA
KNITTER & ASSOCIATES
architecture & planning
2008009 03/12/2008

Figure No. 7-17

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

RENDERING OF PROPOSED
PUMP STATION

$FILE$ 3/30/2010

7-10 STRUCTURAL DESIGN

The structure shall be designed in accordance with the current edition of the American Concrete Institute Building Code Requirements for Reinforced Concrete. The 28-day compressive strength of the concrete shall be 4000-psi. Structural steel design shall be in accordance with the specifications set forth in the current edition of the Manual of the American Institute of Steel Construction.

7-10.1 Foundations

The type of foundation structure required shall be determined from a detailed analysis of soil engineers report. Determinations should include bearing capacity, shearing strength, angle of internal friction and types of soil encountered. Where bearing capacity of soil is too low for support of structure, bearing pile structure should be designed where non-uniform lateral pressures are large, batter piles shall be considered.

7-10-2 Design Loads

The following criteria in Table 7-7 will be used for the structural design of the pump station.

TABLE 7-7
DESIGN LOADS

Roof	Twenty pounds per square foot. Uniform load, or 300 pounds concentrated load, which ever is greater.
Pump Room Floors	Two hundred pounds per square foot, or heaviest piece of equipment, or loaded H15 truck, which ever is applicable.
Pump Supports	Weight of pumps and contents plus thrust plus 50 percent impact.
Active Earth Pressure Plus Saturation	In accordance with recommendations of soil engineer's report.
Stairways and Landings	One hundred pounds per square foot
Wind and Seismic	Loads per California Building Code
Crane Runway	Acceptable allowances in terms of live load
Impact	Twenty-five percent
Lateral Force	Twenty percent
Longitudinal Force	Ten percent

7-11 SEAL WEIR STRUCTURE

As discussed in Section 7-2, a seal weir will be required on the discharge of the pumps to control pumping head when the water level in the Basin is high. The structure is 17 feet wide and 67 feet long.

To create a water surface elevation of 114.0 feet at a pumping rate of 400-cfs, the top of weir must be set at elevation 112.5 feet. Water surface elevation at various pumping rates is shown in Table 7-8.

TABLE 7-8
CALCULATED WATER SURFACE ELEVATION UPSTREAM OF SEAL WEIR

Pumping Rate (cfs)	Upstream Water Surface Elevation
133	113.2
200	113.4
270	113.6
300	113.7
350	113.9
400	114.0

Because the seal weir blocks gravity flow out of the Basin, slide gates are proposed in the weir wall. Two 5-foot by 5-foot non-rising stem type gates are proposed. If the pump station were to fail, these gates could be opened by the motor to allow water to flow from the Basin to the downstream channel.

Also located in the upstream compartment of the seal weir is a stilling well for the level transducer. The purpose of the transducer is to control flow from the pump station by adjusting pump output to maintain a constant downstream level so that downstream channel capacity is not exceeded. Two transducers will be provided for redundancy.

The top of the seal weir will be concrete with grated openings for inspection purposes and access. Access will be from ladders, one for each area of the weir structure. The top has been set at elevation 121.0 feet, which is approximately 9 feet above the surrounding ground, to prevent people from easily climbing on top of the structure.

7-12 CONNECTION TO THE DOWNSTREAM CHANNEL

A 7-foot by 5.5-foot high RCB will be constructed from the seal weir structure to the existing downstream channel to allow water discharged from the pump station to be conveyed downstream.

7-13 HAZARD HOUSE

The County has requested a 15-foot by 15-foot hazardous material house to be located in the vicinity of the pump station. It will be used for storing engine oil, gear oil, and will incorporate an additional air compressor. The Hazard House will feature shelves, benches, and ventilation fans.

7-14 NOISE AND VIBRATION MITIGATION

The pump station will be located in a park setting adjacent to single family residential homes. Controlling noise and vibration generated by the pumps and engines at the station will be an important element of the project.

Included in AKM's scope of work is the preparation of a Noise Study to address potential impacts to the nearby homes. This work will be completed by Wieland and Associates as a subconsultant to AKM. As this study will be used as part of the environmental documentation for the project, and it is something that could be challenged in court, it must represent as closely as possible the final facility after it is constructed. AKM decided that it would not be wise to proceed with the Noise Study until the project concept is more accurately defined. It is believed that an approved, Final Preliminary Design Report is the level of completeness that is necessary before work should be authorized on the Noise Study.

Good design practice dictates that, at a minimum, certain noise and vibration control measures be included in every project. At Haster Basin, the following features, at a minimum, will be incorporated into the design. Additional noise control systems or modifications to those proposed herein will be incorporated as recommended by the Final Noise Study.

7-14.1 Vibration

Excessive vibration can be detrimental to the pump station building structure, piping and equipment, and adjacent residences. Typical sources of vibration in a pump station include: reciprocating machinery such as engines or compressors and out of balance centrifugal equipment such as fans or pumps. Vibration control measures which will be incorporated into the project will include the following:

- *Engine Base, Size and Isolation* – Concrete mounting bases for the natural gas engines will be isolated from the building floor slabs by an expansion joint which is continuous around the base. In accordance with recommended design practices by engine manufacturers, the weight of the concrete base will be twice that of the engine dry weight.

- *Installation of Vibration Isolators on the Fan and Genset* – Open spring vibration isolators will be installed on the generator mounting skid and fan base to dampen vibrations from those pieces of equipment. The vibration isolators will also be designed with lateral restraint to resist earthquake forces. A neoprene pad is usually placed under the isolators to reduce the transmission high frequency energy. Neoprene pads can also be installed between the pump base plate and floor to reduce the transmission of energy into the building from the pump and right angle gear drive.

- *Proper Pump Selection* – Pumps are designed to be balanced at their best efficiency point (BEP). Operating too far to the left or right of the BEP can cause unbalanced forces on the pump impeller and cavitation. To limit this from occurring, the pump operating range should be within 60% and 120% or the best efficiency capacity.

- *Limit Velocities in Piping System* - Vibrations in pressure piping systems can begin to occur at velocities in excess of 7-ft/sec. Piping systems will be sized to limit velocities under this threshold.

- *Design of Building Structure* – Excessive building vibration usually only occurs when the structural resonance frequency is nearly equal to the driving frequency of a piece of equipment, such as a pump. As part of the structural design, an analysis will be performed to ensure that resonance vibration of the structure will not occur.

7-14.2 Noise

Noise is a concern for County personnel operating the pump station and for those who live in the surrounding area. The City of Garden Grove Noise Ordinance restricts noise levels to a maximum of 45 dBA between 10:00 p.m. and 7:00 a.m. at the property line of the nearest adjacent neighbor, or 5 dBA above the ambient noise level of a 24-hour noise level reading. To reduce the transmission of noise from the pump station, the following measures will be incorporated into the project.

- *Install Sound Panels on Walls and Ceiling* – Sound panels are an effective means of absorbing noise and eliminating reverberation. A typical panel consists of a perforated, corrugated metal exterior covering 2 inches of sound absorbing insulation. The corrugated metal surface diffuses sound by deflecting it in different directions. It also provides a protective exterior for the sound absorbing insulation installed beneath. Sound panels reduce noise levels inside the pump room, which is important for the operator, and absorb noise that otherwise may be transmitted to surrounding areas.
- *Use Acoustic Doors and Louvers* – All doors specified for the project will have a sound transmission class (STC) of 49. The STC is a single number rating which describes the ability of a material to resist sound transmission. A higher number generally indicates a greater ability to attenuate sound. For comparison, a typical door would have an STC rating of 25. Louver openings allow significant levels of noise to be transmitted from buildings. Acoustic louvers help reduce noise by absorbing high and low frequency sounds generated from mechanical equipment.
- *Solid Grouting of Pump Station Block Walls* – Solid grouted block walls improve the sound attenuation of the building. A typical STC rating for a solid block wall is 50, which is 10 points higher than a hollow block wall.
- *Direct Louvers, Doors, and Engine Exhausts Away from Homes* – The pump station layout attempts to locate any type of opening from where sound transmission would be greatest, away from homes located to the south of the pump station.
- *Provide Super Critical Silencer for Generator and Engine Exhaust* – Super critical grade silencers will be specified on the exhaust of all engines at the station. The super critical grade silencer provides the highest level of noise attenuation available (45-52 dB‘A’). For comparison, a typical critical grade muffler (hospital quality) is 25-33 dB‘A’.
- *Provide Sound Attenuated Outdoor Enclosure for Emergency Generator* – The outdoor enclosure for the emergency generator will be specified to provide the highest sound reduction levels which are commercially available (65 dB‘A’ at 10 feet).

7-15 SECURITY SYSTEMS

The proposed pump station will be located in a public park. A security fence will enclose the entire facility along the route of the perimeter road. Security provisions will be installed at the proposed pump station to protect the facility from intrusions and vandalism. These measures are as follows:

7-15.1 Minimize Facilities Outside of the Building

An attempt has been made in the layout of the pump station to minimize the amount of equipment which is placed outdoors. Where an outdoor location cannot be avoided, the equipment is enclosed by a 6-foot steel picket fence with the pickets directed outward at the top. In most instances, the outdoor equipment installed in this secured area will be located within its own outdoor rated locked steel enclosure. Systems which cannot be installed within an enclosure, such as the LPG fuel tanks and vaporizer, are secured by a second 6-foot picket fence enclosure.

7-15.2 Minimize Accessibility to Doors and Louvers by the General Public

Most of the doors and louvers required for the pump station have been located behind a 6-foot steel picket fence. Louvers which could not be located within the enclosed area have been placed high so they cannot be reached without a ladder.

7-15.3 Anti-Graffiti Measures

Anti-graffiti paint will be used on all building exterior surfaces.

7-15.4 Install Security Lighting Around the Building

Security lighting will be installed around the entire facility. The lighting will be designed so that it can be left on through the night or activated by motion detectors. Lights will be placed on poles or high enough on the building so that they cannot be accessed without a ladder.

7-15.5 Install Intrusion System on Building Doors

Intrusion detection switches will be installed on each door of the proposed pump station. An intrusion control panel will be located in the pump station office, which will be capable of activating or deactivating the system by use of a key. Upon entering the building, an operator must deactivate the system using their key within 1-minute (or other predetermined time period), otherwise an alarm signal will be sent through the SCADA system that an intrusion has occurred at the site. When leaving the pump station the operator must activate the intrusion system by using their key. The operator will have 5-minutes (or other predetermined time period) to exit the building. Should the operator forget to activate the intrusion system, a signal will be sent through the SCADA system indicating the intrusion system is in the disarmed position.

7-16 BRIDGE CRANE

A 5-ton bridge crane will be provided in the pump station for use in maintaining the engines, right angle gear drive and removal of the sump pumps.

The crane will include a motorized bridge and will have a motorized trolley, and single hook hoist that can be operated from the floor by a control pendant. Minimum hook height will be 16 feet.

Two bridge crane configurations are available: a single girder under-hung unit and a top riding single girder type.

The single girder under-hung crane is the same type which was installed at the Rossmoor Storm Water Pump Station, and is proposed to be installed at the Los Alamitos Pump Station. In this design the crane support beam is attached to the underside of the roof truss. The bridge trolleys hang underneath the beam. The advantage of this type of system is that pilasters normally used to support the crane are not required, thereby reducing the width of the building. The disadvantage of this approach is that the roof truss must be designed stronger to carry this load.

The top riding crane rides on top of a rail which is welded to an I-beam supported by a pilaster. With this design, the building width is increased by 3'-4".

To remain consistent with previous County designs, the project will incorporate an under-hung bridge crane. *A Craneveyor Z-10 Series is recommended, with a Yale wire rope hoist and motorized trolley.*

7-17 SUMP VENTILATION FAN

To promote a safe working environment in the sump, a ventilation fan will be provided. The fan will blow air into the sump at a rate of 17,000-cfm, which is equivalent to an exchange rate of 12 times per hour. Fiberglass reinforced plastic (FRP) ducting will be used to convey the air in the sump. Ductwork will be designed for a maximum velocity of 2,000-fpm to limit the production of noise. The duct will be installed as high as possible in the sump so that it is not susceptible to flooding. Registers will be located at regular intervals in the ductwork and will be designed to produce a throw sufficient for the air to be felt at the bottom of the sump floor.

The fan will be located in the pump room and will receive its air intake from an unfiltered louver to the outside, and sheet metal ductwork. A damper will be provided on the intake side of the fan to control its output.

The recommended fan is an Aerovent Model 38W718 vane axial fan. It is rated for 17,731-cfm at 2.5 inches water column, and 1,750-RPM. Motor horsepower is 10. The fan will be designed to automatically start when a person enters the stairwell to the sump, or manually. Controls will also be provided to inhibit the fan from running if the wet well level exceeds the elevation of the ducts in the sump.

7-18 PUMP ROOM VENTILATION FANS

Roof-mounted exhaust fans will be provided with capacity sufficient to produce 30 air charges in the pump room. Roof fans will be direct drive type, incorporating a roof curb and intake damper. A total of 10 fans will be provided, each with a rated capacity of 4,000-cfm at 0.25-inch W.C. pressure. Roof fans will be thermostatically controlled, but will also be capable of being started and stopped manually. *Recommend roof fan is Greenheck G-180-B*. The proposed roof plan for the building shows the fan locations is provided on Figure 7-16.

7-19 RAIN GAUGE

To measure rainfall at the site, a tipping bucket-style rain gauge is recommended to be installed on the roof. The rain gauge will be calibrated to count 0.01-inch per tip. The tip count signal will be sent to the central controller for data logging. *The recommended rain gauge is a Nova Lynx 260-2500.*

7-20 SERVICE AIR

Service air for pneumatic tools will be provided at the facility. Typical air requirements for various types of tools are shown in Table 7-9 below.

TABLE 7-9
PNEUMATIC TOOLS AT 90 PSI

Tools	Air Consumption (cfm)
Drill	60-80
Grinder	30-40
Impact Driver	4-12
Hammer	30-40
Screw Driver	20
Wrench	40

Air stations will be located throughout the building for operator convenience.

The air compressor will be a rotary screw type with a capacity of 68-cfm at a discharge pressure of 100-psi. The unit will be equipped with a 120-gallon receiver tank, dryer and filter. Motor horsepower will be 15. The proposed unit is an Atlas Copco GAU 15-100.

7-21 LEVEL TRANSDUCERS

Level transducers will be installed in the sump, and in the outlet structure. Level transducers will be provided in pairs for redundancy, and will be installed in a stilling well. A desiccant box will be provided to keep the vent tube free of condensation.

The level transducer in the sump will be used to stage the pumps on and off. The level transducer in the outlet structure will be used to trim pump speed as the Basin level increases so that the overall pump station output does not exceed the capacity of the downstream channel.

Recommended level transducers are Rittmeyer 2-wire MPU.

7-22 EXPLOSIVE GAS DETECTOR

A gas detector will be installed in the engine room to measure for the presence of natural gas or LPG. If detected, an alarm will be sent to the central control panel and relayed through the SCADA system to notify operations personnel of the condition.

7-23 ELECTRICAL SYSTEM

The electrical installation for all work in the sump will be in accordance with a Class 1 Division 2 hazardous location as defined by NFPA 70 (National Electric Code; NEC). All electrical work in areas above-grade shall be under classified.

7-23.1 Pump Station Electrical Loads

The electrical load requirement for the pump station is 350-amps. Table 7-10 provides a breakdown of the estimated electrical loads.

TABLE 7-10
ESTIMATED ELECTRICAL LOADS BREAKDOWN

Item	Size	Full Load Amps (FLA)
3,000-gpm Sump Pump	100-hp	124
500-gpm Sump Pump	20-hp	27
Bridge Crane	7.5-hp	11
Air Compressor	15-hp	21
Sump Fan	7-hp	14
480v – 120/240v Single Phase Transformer	50-KVA	104
25% of Largest Motor	--	31
Future Park Loads	--	10
TOTAL		**342**

7-23.2 SCE Meter and Main Disconnect

SCE requires that the service meter be located in its own room for the protection of Edison employees that will be reading the meter. To comply with this requirement, a small alcove has been designed on the side of the building to house the Edison meter, main disconnect switch, and automatic transfer switch for the emergency generator. The length of the service cabinet is estimated to be 8 feet. An elevation of the switchboard is provided on Figure 7-18. The location of the switchboard on the pump station site is shown on Figure 7-14.

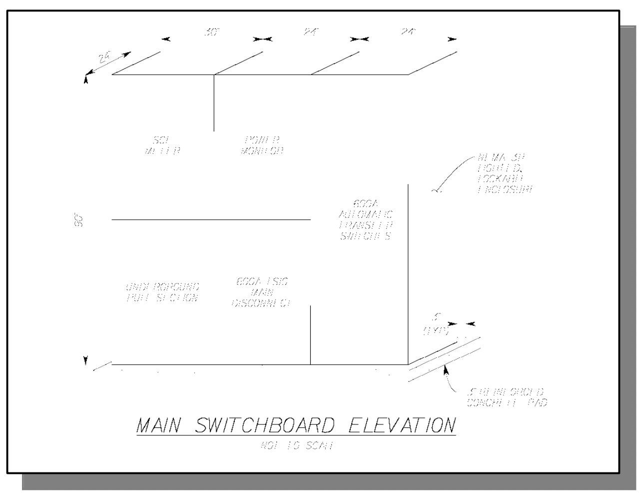


FIGURE 7-18. Main Switchboard Elevation

It is important to note that a service plan from SCE has not been obtained for the project. The information concerning meter location, transformer location, and service pick-up point are based upon verbal discussions with the service planner and AKM's experience with similar projects. Final arrangement of the SCE service equipment may change and will be based upon the service plan prepared by SCE.

7-23.3 Motor Control Center (MCC)

The motor control center will be located in the electrical room of the pump station building. Starting equipment for the sump pumps, ventilation fan, and air compressor will be located in these cabinets.

The motor control center will also include distribution circuit breakers for the bridge crane and park lighting system, as well as the lighting transformer and load center. The estimated length of the motor control center is 10 feet. An elevation of the proposed cabined is shown on Figure 7-19.

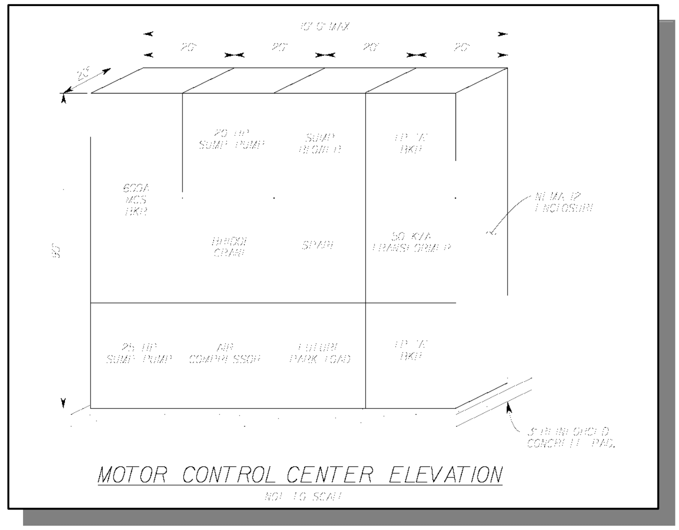


FIGURE 7-19. Motor Control Center Elevation

7-23.4 Emergency Generator

A 350-kW, natural gas emergency generator will be provided to maintain power to lighting and ventilation system during a commercial power outage. The generator has been sized to limit the maximum voltage dip to no more than 20%. The unit will be installed outside in a weather resistant, sound attenuated, lockable enclosure. It will be provided with a block heater, battery charger, control panel, and batteries; all installed within the enclosure. An automatic transfer switch will be provided to automatically start the generator and switch power to the Genset during a commercial outage. The recommended generator make is Caterpillar.

7-24 PUMP STATION CONTROL SYSTEM

7-24.1 General

Pump operation will be affected by a level control system. The primary measurement devices will be two level transducers (primary and back-up) mounted within a stilling well in the sump. Float switches will be provided to supply emergency operation in the event of transducer or central control panel failure. A level transducer and float switch back-up will also be provided in the seal weir structure to control station output to no more than 400 cfs.

7-24.2 Control System

The pump station will incorporate a Murphy-type engine control system. The system shall consist of a dedicated central controller and individual engine controllers. The central controller will be programmed to call and shutdown pumps, as well as communicate with the County's SCADA system through a telephone modem connection. The engine controllers will monitor and control their dedicated engine, based upon information provided by the central controller. The engine controllers will communicate with the central controller through a serial port connection and MODBUS communications protocol.

7-24.3 Central Controller

The central control panel will be a microprocessor based unit, incorporating display and control hardware and software to allow visual monitoring and easy access to control set points. It will also incorporate a data event logger which will store status and alarm information for the pump station.

The central controller will be in constant 2-way communication with the SCADA base station computer, and will be capable of sending status information, and affect remote operation commands.

The operational program for the pump station will utilize an approach which will call pumps and adjust their speed to maintain a constant downstream level in the seal weir structure. The sequence of operation is described below.

STORM MODE OPERATION

Start Sequence

A. If the level in the sump has risen to (or above) the field selected, sump pump start level; the adjustable, "Delay on Start" timing period shall begin timing. If conditions continue to satisfy the start requirements throughout this period, the sump pump or diversion pump will be called to start.

B. If the level in the sump has continued to rise to (or above) the start level set point; the adjustable "Delay on Start" timing period begins timing. If the conditions continue to satisfy the start requirement throughout this period, the lead engine will be signaled to start.

C. When the engine has successfully started and completed its warm-up timing period, the automatic throttle control system shall begin to operate.

    1. The engine shall first be signaled to throttle up to the "minimum RPM" setting field selected in the central controller. The automatic throttle control program shall then signal the engine driven pump to increase its speed to the maximum RPM setting.

Programming, as well as hardware capability, shall exist within the central controller to modulate engine speed to automatically maintain a constant level in the seal weir structure.

D. If the level in the sump has continued to rise to (or above) the field selected, start level set point; the adjustable, delay on start timing period shall begin timing. If the conditions continue to satisfy the start requirement throughout this period, the first follow engine will be signaled to start. Speed of the lead and follow pump is adjusted together to maintain a constant level in the seal weir structure.

E. If the sump level continues to rise, the remaining engine will be started and controlled as described above.

Stop Sequence

As the inflow to the sump subsides, the level will fall to the stop level. If the level remains below this field-selectable set point throughout the delay on stop time, a shutdown sequence will begin for the last follow engine on line.

A. Engine-mounted throttle actuator is disconnected from the manual or automatic throttle control and is signaled to return to its full idle position. Control is transferred to the individual engine control panel and the engine is shutdown (see sequence under the engine control panel).

B. The remaining engine-driven pumps will be dropped, as described above, as its pumping capacities are no longer needed.

C. Once all engine-driven pumps are offline, the sump pump will be called to run after a pre-set time delay.

ENGINE CONTROLLERS

The engine controller is used to monitor and operate each engine based upon commands provided by the central controller. The panel announces engine failures through an alpha-numeric display. The panel will shutdown an engine should any of the following occur:

- Low Oil Pressure
- High Water Temperature
- Overload/Underload
- Low Coolant Level
- High/Low Engine Oil Level
- Excessive Vibration
- Overspeed
- Overcrank
- Loss of Speed Signal
- High Catalytic Converter Temperature

The start and stop sequence executed by each engine controller is as follows:

A. Power is supplied to the solenoid fuel valve.

B. Cycle cranking begins: Crank 10 seconds; rest 10 seconds until engine starts or over crank program operates. Over crank is indicated on display and common engine failure status light is turned on.

  1. When engine speed rises above the field-programmable crank disconnect speed setting, an automatic run sequence begins:

    a) Cycle cranking is disconnected immediately

    b) Engine running lamp lights

    c) Internal "hour meter" program begins to record engine running hours.

    d) The engine-mounted throttle actuator is signaled to slowly increase engine speed to the field-programmable "warm-up" RPM.

    e) Two timing periods begin:

      1) Safety lockout time delay

      2) Warm-up time delay

    f) When the preset, safety lockout delay expires:

      1) The following shutdown circuits are "armed:"

        (a) Low Oil Pressure

        (b) High Water Temperature

        (c) Loss of Speed Signal

        (d) High Catalytic Converter Temperature

    g) When the warm-up timing period expires, the engine-mounted throttle actuator is controlled either by the automatic throttle control program or by a local, manual throttle control circuit.

C. When the engine has successfully started and completed its warm-up timing period, the automatic throttle control system shall begin to operate.

Stop Sequence

When called to stop by the central controller, the following stop sequence is initiated.

Engine-mounted throttle actuator is disconnected from the manual or automatic throttle control and is signaled to return to its full idle position.

A field-programmable cool-down time delay period begins timing. When this delay expires:

1. Internal "hour meter" program stops recording and stores current engine running hours.
2. All shutdown circuits are locked out.
3. Engine running status lamp goes out.
4. Battery (+) is removed from the solenoid fuel valve circuit.
5. Contacts close to start pre/post lube pump for adjustable time delay period.
6. Control circuits automatically reset for next start sequence.

Emergency Operation

In the event of level transducer failure, Loss of Communications between Central Controller and Engine Controllers, or a High-High Float signal, a back-up Emergency Operation feature will be included. The engine control panel shall be capable of starting when signaled by back-up float switches. The float switches shall provide independent start signals directly to the engine controller. When the signal is received, the panel shall annunciate "Emergency Operation," start and run the appropriate pump, and after the warm-up period has expired, signal the engine to run and modulate its speed based upon a signal from a float in the seal weir structure. "Emergency Operation" is automatically reset when the control panel is signaled by a stop level float switch, however the "Emergency Operation" light will remain on until manually reset by operator.

7-25 TELEMETRY SYSTEM

The County currently uses spread spectrum radio telemetry to monitor its pumping facilities.

A potential list of status signals to be communicated by telemetry are as follows:

A. Engine 1, 2, 3 Fail
B. Engine 1, 2, 3 Run
C. Sump Pump Run
D. Generator Run
E. Sump Level
F. Engine 1, 2, 3 Speed
G. Engine Running Time
H. Sump Pump Fail
I. Seal Weir Level
J. Sump High Level
K. Engine 1, 2, 3 Low Battery Voltage
L. Intrusion
M. Commercial Power Fail
N. Generator Fail
O. Natural Gas System Fail
P. Explosive Gas Alarm

In addition, if desired, the following signals may be transmitted to the facility for remote operation of the station.

A. Call/Stop Engine 1, 2, 3

B. Call/Stop Sump Pump

C. Sump Pump Start/Stop Level Set Points

D. Engine 1, 2, 3, Start/Stop Level Set Points

E. Increase/Decrease Engine 1, 2, 3 RPM

F. Set Engine 1, 2, 3 RPM

AKM will work closely with the County staff to develop the telemetry system as necessary for the final project requirements.

Section 8
SITE IMPROVEMENTS

8-1 INTRODUCTION

To improve access, security and flood protection, miscellaneous improvements will be required at the site. This section of the report will address these issues, as well as utility services and property acquisition requirements for the project.

8-2 PUMP STATION SITING ALTERNATIVES

Four alternatives for siting the pump station have been identified. Each alternative is located in the southwest corner of the site, near the outlet channel. This area was selected because it results in the shortest length of discharge pipe from the pump station and is close to the Aspenwood Lane access road. There is also more room in this area to construct the pump station than any other location on the Haster Basin site.

Other potential placements around of the Basin would all have similar aesthetic and noise impacts to the surrounding residential homes, except in the extreme northeast corner of the site, near the inlet of the East Garden Grove-Wintersburg Channel. This location was rejected because of the complexities and cost associated with constructing an intake structure to the pump station, and the 1,500-LF of 108-inch discharge pipe that would be required to be constructed to the downstream channel. The long discharge pipe would have the secondary effect of creating more pumping horsepower, and larger engines for the project.

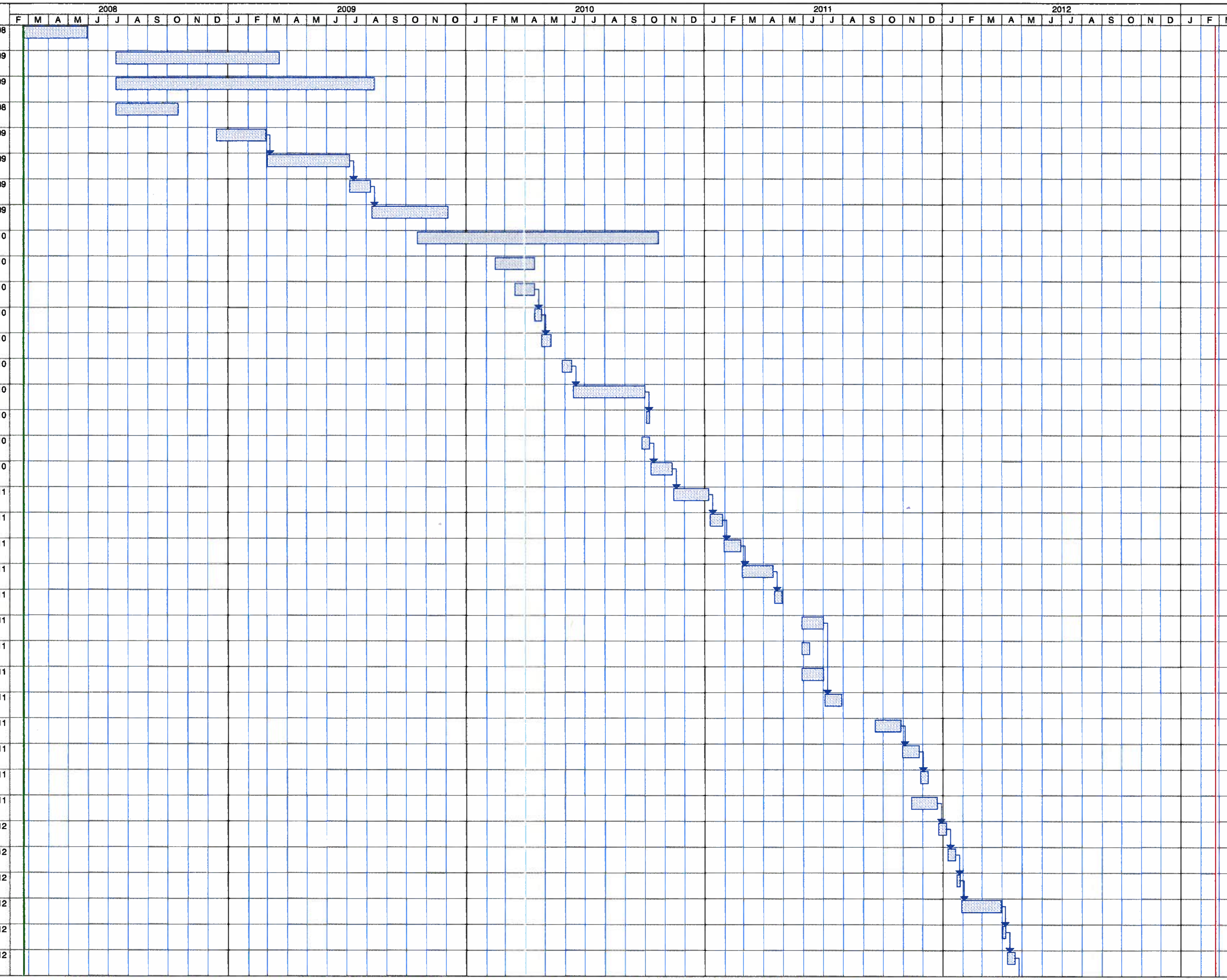
A description of the four siting alternatives is provided below. A map showing the location of each alternative is provided on Figures 8-1 and 8-2.

ALTERNATIVE 1

Alternative 1 has the pump station aligned with the East Garden Grove-Wintersburg Channel, but the outlet to the channel is on the end of the weir outlet box. This is less desirable hydraulically. While the pump station is further away from the homes to west than Alternative 2 it is more visually disruptive to the homes south of the pump station. The benefits of this alternative are that it has unimpeded access from Aspenwood Lane and a larger turnaround area for maintenance vehicles than Alternative 2.

PROJECT SCHEDULE
Haster Basin Project
September 2008

ID	Task Name	Duration	Start	Finish
1	Preliminary Design Report Approval	71 days	Fri 2/22/08	Fri 5/30/08
2	Environmental Documentation	180 days	Mon 7/14/08	Fri 3/20/09
3	Plan and Specification Preparation	284 days	Mon 7/14/08	Thu 8/13/09
4	Resource Agency Permits	70 days	Mon 7/14/08	Fri 10/17/08
5	Bid Period	55 days	Mon 12/15/08	Fri 2/27/09
6	Project Award	91 days	Mon 3/2/09	Mon 7/6/09
7	Contract and Insurance Documents	24 days	Tue 7/7/09	Fri 8/7/09
8	Shop Drawing Reviews	85 days	Mon 8/10/09	Fri 12/4/09
9	Equipment Procurement (long lead time items)	265 days	Mon 10/19/09	Fri 10/22/10
10	Mobilization	44 days	Mon 2/15/10	Thu 4/15/10
11	Initial Basin Dewatering	22 days	Wed 3/17/10	Thu 4/15/10
12	Install C05 and Oertley Diversion System	7 days	Fri 4/16/10	Mon 4/26/10
13	Construct Access Road from Haster Street	10 days	Tue 4/27/10	Mon 5/10/10
14	Complete Basin Dewatering	11 days	Fri 5/28/10	Fri 6/11/10
15	Clear, Grub and Grade Basin	80 days	Mon 6/14/10	Fri 10/1/10
16	Reconstruct City of Garden Grove Well Outlet	5 days	Mon 10/4/10	Fri 10/8/10
17	Construct City of Garden Grove Irrigation Service Connection	10 days	Mon 9/27/10	Fri 10/8/10
18	Install Site Irrigation System	25 days	Mon 10/11/10	Fri 11/12/10
19	Construct Basin Perimeter Road	40 days	Mon 11/15/10	Fri 1/7/11
20	Restore Park Landscaping, Construct Recreational Improvements, Install Perimeter Fence	15 days	Mon 1/10/11	Fri 1/28/11
21	Demolish Existing City of Garden Grove Water Well and Monitoring Wells	20 days	Mon 1/31/11	Fri 2/25/11
22	Install Groundwater Monitoring Wells and Settlement Monitors (conduct pre-construction video survey)	35 days	Mon 2/28/11	Fri 4/15/11
23	Demolish Exist'g City of Garden Grove PS, Outlet Channel Headwall, Misc. Piping Sys., Exist'g Paving	10 days	Mon 4/18/11	Fri 4/29/11
24	Install Sheet Piling	25 days	Mon 5/30/11	Fri 7/1/11
25	Install Diversion Channel	10 days	Mon 5/30/11	Fri 6/10/11
26	Excavation Inside Coffer Dam. Install Bracing on Sheet Piling	25 days	Mon 5/30/11	Fri 7/1/11
27	Construct Sump Foundation	20 days	Mon 7/4/11	Fri 7/29/11
28	Construct Sump Walls and Stairs	30 days	Mon 9/19/11	Fri 10/28/11
29	Construct Seal Weir Structure (do not construct interior wall or deck)	20 days	Mon 10/31/11	Fri 11/25/11
30	Install 54-Inch Discharge Pipes and 36-Inch Drain Pipe	10 days	Mon 11/28/11	Fri 12/9/11
31	Rough-In Below Grade Conduits	30 days	Mon 11/14/11	Fri 12/23/11
32	Construct Building Footing	10 days	Mon 12/26/11	Fri 1/6/12
33	Construct Engine Bases	10 days	Mon 1/9/12	Fri 1/20/12
34	Construct Building Floor Slab	5 days	Mon 1/23/12	Fri 1/27/12
35	Construct Block Building	45 days	Mon 1/30/12	Fri 3/30/12
36	Install Pumps	5 days	Mon 4/2/12	Fri 4/6/12
37	Install Engines	10 days	Mon 4/9/12	Fri 4/20/12

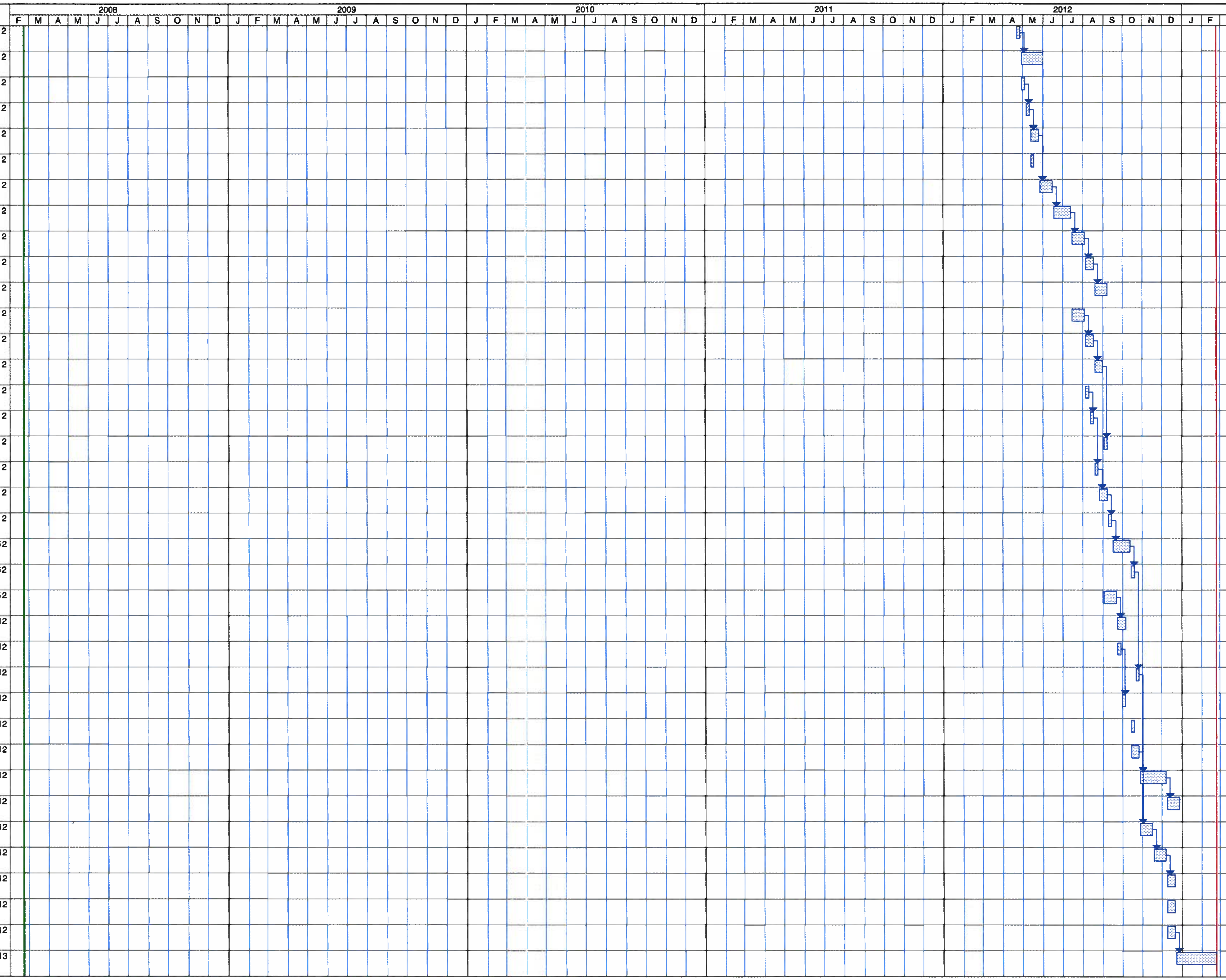


Task | Split | Progress | Milestone | Summary

FIGURE 9-1

PROJECT SCHEDULE
Haster Basin Project
September 2008

ID	Task Name	Duration	Start	Finish
38	Install Stairs to Roof	5 days	Mon 4/23/12	Fri 4/27/12
39	Install Roof System	25 days	Mon 4/30/12	Fri 6/1/12
40	Install Sump Stairs	5 days	Mon 4/30/12	Fri 5/4/12
41	Install Sump Pumps	5 days	Mon 5/7/12	Fri 5/11/12
42	Install Heat Exchanges and Misc. Sump Piping	10 days	Mon 5/14/12	Fri 5/25/12
43	Install Ductwork in Sump	5 days	Mon 5/14/12	Fri 5/18/12
44	Install Trash Rack	15 days	Mon 5/28/12	Fri 6/15/12
45	Pull Sheet Piling	20 days	Mon 6/18/12	Fri 7/13/12
46	Backfill Around Structure	15 days	Mon 7/16/12	Fri 8/3/12
47	Dewater Basin to Elevation 90-Ft.	10 days	Mon 8/6/12	Fri 8/17/12
48	Construct Concrete Road to Pump Station Trash Rack	15 days	Mon 8/20/12	Fri 9/7/12
49	Construct Outlet RCB Connect to Existing Outlet Storm Drain	15 days	Mon 7/16/12	Fri 8/3/12
50	Install 4-Inch Water Service from City of Garden Grove	10 days	Mon 8/6/12	Fri 8/17/12
51	Install 4-inch Sewer Service from City of Garden Grove	10 days	Mon 8/20/12	Fri 8/31/12
52	Install Electrical Service Transformer Slab Box	5 days	Mon 8/6/12	Fri 8/10/12
53	Install SCE Service Conduits	5 days	Mon 8/13/12	Fri 8/17/12
54	Install SCG Gas Service (by SCG)	5 days	Mon 9/3/12	Fri 9/7/12
55	Install Telephone Service Conduits	5 days	Mon 8/20/12	Fri 8/24/12
56	Install Yard Conduits Set Outdoor Meter Service	10 days	Mon 8/27/12	Fri 9/7/12
57	Set Indoor MCL - Install Murphy Control Panels	5 days	Mon 9/10/12	Fri 9/14/12
58	Install Building Conduit Pull Wire	20 days	Mon 9/17/12	Fri 10/12/12
59	Install Building Lights	5 days	Mon 10/15/12	Fri 10/19/12
60	Install Misc. Piping in Pump Room Bathroom	15 days	Mon 9/3/12	Fri 9/21/12
61	Install Sump Supply Fan and Roof Exhaust Fans	10 days	Mon 9/24/12	Fri 10/5/12
62	Install Generator	5 days	Mon 9/24/12	Fri 9/28/12
63	Energize Edison Service	5 days	Mon 10/22/12	Fri 10/26/12
64	Install LPG Tanks, Vaporizor and Piping	5 days	Mon 10/1/12	Fri 10/5/12
65	Construct 6-foot Wall at Property Line	5 days	Mon 10/15/12	Fri 10/19/12
66	Construct Flood Walls	10 days	Mon 10/15/12	Fri 10/26/12
67	Start-Up Testing	30 days	Mon 10/29/12	Fri 12/7/12
68	Construct Seal Weir Wall and Top Deck	15 days	Mon 12/10/12	Fri 12/28/12
69	Installation of Irrigation System Piping	15 days	Mon 10/29/12	Fri 11/16/12
70	Yard Paving and Perimeter Fence	15 days	Mon 11/19/12	Fri 12/7/12
71	Building Stucco Finish	10 days	Mon 12/10/12	Fri 12/21/12
72	Operator Training	10 days	Mon 12/10/12	Fri 12/21/12
73	Landscaping	10 days	Mon 12/10/12	Fri 12/21/12
74	Punch List	45 days	Mon 12/24/12	Fri 2/22/13



Task Split Progress Milestone Summary

ALTERNATIVE 2

Alternative 2 has the pump station centered on East Garden Grove-Wintersburg Channel. This makes it the best hydraulic alternative. The pump station is 34 feet and 88 feet from homes to the south and west respectively, which makes it the second most acoustically advantageous alternative. Finally, there is a sizable paved area for maneuvering large trucks or a crane.

ALTERNATIVE 3

Alternative 3 is very similar Alternative 2 in that the pump station is centered on EGGWC. However the pump station's location is pushed further out into the Basin. It is more acoustically advantageous because it is 112 feet and 82 feet from the nearest homes. It is hydraulically similar to Alternative 2, but the RCB outlet will be longer. It will be the most expensive to construct because of the required extra grading, pavement, and longer outlet.

ALTERNATIVE 4

Alternative 4 provides the worst hydraulic arrangement because a curved outlet pipe or concrete box will be required, and water will not enter the channel tangentially. Additionally, it provides no acoustic advantage, and may be more visually disruptive to the homes to the west. The alternative also provides no turn-around area for large maintenance vehicles.

All alternatives were presented at a regularly scheduled project meeting with the County for discussion. County operations personnel preferred Alternative 1 because of the large area provided to the west of the pump station to maneuver maintenance vehicles. Therefore Alternative 1 was chosen for siting of the pump station.

8-3 SITE ACCESS

Operation of the pump station and Basin will require access, which is suitable for the large maintenance vehicles to be used by the County.

Vehicular access to the site is currently available from Aspenwood Lane, via a 25-foot wide paved drive, located adjacent to the channel. Access is also available through the park's parking lot. Once on site, an 8-foot wide paved road, which is also used as a walking and bicycling trail, encircles the Basin.

The City of Garden Grove restricts access to residential streets by large construction/maintenance equipment. In a letter from the City of Garden Grove to the County of Orange dated April 23, 2004, the City requested that the entrance on Aspenwood Lane be used by large maintenance vehicles only 2 to 3 times per year. The City also requested that the County restrict their maintenance activities to regular working hours, except in the case of emergencies. A copy of the City's April 23rd letter has been included in the Technical Appendices, Section E for reference.

Vehicles which will be used to maintain Haster Basin and the proposed pump station are as follows.

- *Vactor Truck* – A vactor truck would be used to vacuum trash and debris collected inside the sump and CDS unit. The vactor truck will be used at the site on average 2 to 3 times per year. However, more frequent trips may be required depending upon the number of storms that occur during a given rainy season. A picture of the County's vactor truck is shown in Photograph 8-1.

PHOTO 8-1. G.V.W. 58, 000 lbs.

- *Large Crane* – The large crane is used to remove trash collected on the pump station trash rack. Trash is removed on average, 2 to 3 times per year. However, this also may be required more frequently depending upon the number of storms. A picture of the County's large crane is shown in Photograph 8-2.

PHOTO 8-2. G.V.W. 63,000 lbs.

- *14-Ton Crane* – The 14-ton crane would be used to remove pumps for servicing. It would also be used to remove other pieces of large equipment such as the engines or Genset located at the site. Pump removal is estimated by the County to occur every 2-3 years. A photograph of the 14-ton crane is shown in Photograph 8-3.

PHOTO 8-3 G.V.W. 58,000 lbs. "14 Ton Crane"

- *Flatbed Truck and Trailer* – The flat bed truck and trailer would be used to haul large equipment removed from the pump station. It would be used in conjunction with the 14-ton crane, so therefore it would be required every 2 to 3 years. A photograph of the flatbed truck and trailer is shown in Photograph 8-4.

PHOTO 8-4. Truck - G.V.W. 66,000 lbs. Trailer Tare 16,200 lbs., G.V.W. 150,000 lbs.

- *Dump Truck* – Trash removed from the pump station trash rack would be loaded into a dump truck and hauled to a landfill. The dump truck would be used along with the large crane, approximately 2 to 3 times per year, or more frequently, depending upon the number of storms. A photograph of the dump truck is shown in Photograph 8-5.

PHOTO 8-5. Dump Truck

Regular maintenance activities at the pump station would be conducted on a monthly basis and would include: exercising of the engines; inspection of engine fluids; checking of the batteries; and monitoring of the pump control panels. Personnel would travel to the site by pick-up truck to perform this general maintenance.

Access through the park's parking lot is not favored by the County's operations group for large vehicles. Because of the restrictions on the use of Aspenwood Lane, it is necessary to create a new access point to the site. After discussions with the County's operations staff, an entrance from Haster Street, just north of the children's play area was chosen. This third access point is entirely within County property, so no additional right-of-way will be required. As proposed, a 20-foot concrete driveway would be constructed with a 20-foot a.c. drive built to the proposed perimeter road. A lockable swing gate will be placed at the entrance, located far enough up the asphalt drive to allow a vehicle to park while the gate is unlocked and opened.

As an additional feature, a paved turn-around area can also be placed in front of the gate to allow vehicles that have inadvertently turned into the driveway the ability to turn-around and re-enter

Haster Street moving in a forward direction. The existing covered picnic shelter would need to be removed in order for this driveway entrance to be constructed. Figure 8-3 shows the location of the proposed Haster Street entrance.

8-4 PERIMETER ROAD

The existing paved road around the perimeter of the Basin is 8 feet wide, and designed for foot and bicycle traffic. The road is currently in poor condition and would be totally unsuitable for the equipment which would be required to maintain Haster Basin. To provide vehicle access to all areas of the Basin, an a.c. paved perimeter road, 10-foot in width is recommended that is designed for the vehicle weights which will be used by the County for maintenance purposes. The paved road will double as a riding path and will be striped for 2-way bike traffic. Directly adjacent to the paved road will be a 5-foot decomposed granite walking path. It is envisioned that this path will be utilized as part of the maintenance road for the larger vehicles. The proposed perimeter road is shown on Figures 8-3 and 8-4. It is designed with 90-foot radius curves to accommodate large trucks. Its alignment is generally in the same location as the existing road. Trees that have low hanging branches extending over the roadway will be trimmed to eliminate vehicle obstructions.

8-5 SITE DRAINAGE

In general, the site will be graded to prevent drainage from the paved perimeter road from entering the Basin. The general grading concept is shown on Figure 8-3.

Paved areas around the proposed pump station will be graded and curbed to prevent run-off from escaping the site. Yard drains with filtered inserts will be provided as necessary to catch these flows. Concentrated flows from the pump station roof will also be filtered prior to being discharged into the pump station sump.

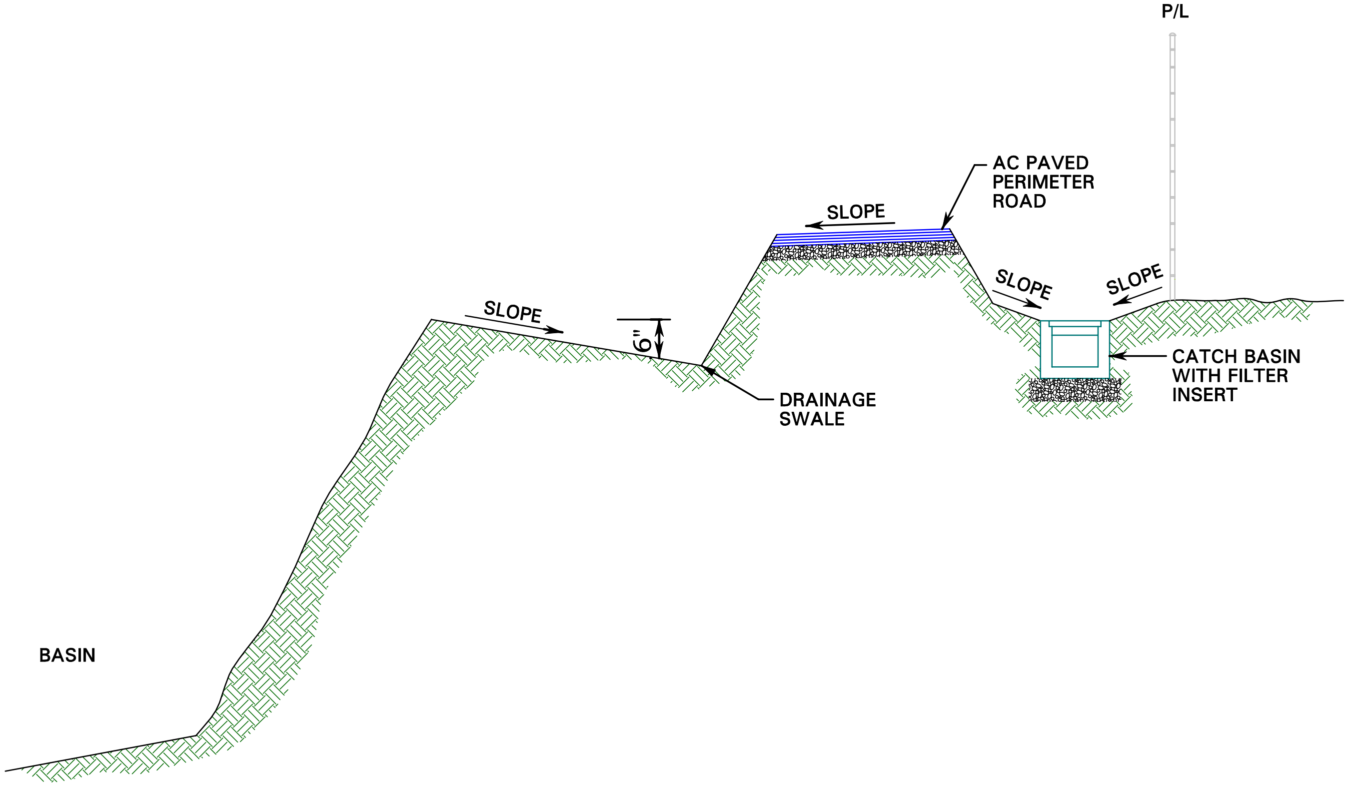
8-6 SITE RESTORATION

In December of 1972, the County of Orange and City of Garden Grove entered into a 25-year agreement to allow the Haster Basin site to be used as a public park. The City, through the agreement, was responsible for developing the park improvements and maintaining the site, except for those facilities expressly devoted to flood control purposes.

The 23-acre Park, now known as Twin Lakes Freedom Park, offers a tranquil setting for picnickers, joggers and bicyclists, and is heavily used year-round by the local community. Facilities available at the Park include a children's play area, jogging trail, exercise course, picnic tables (50-person occupancy), and restrooms. Photographs of the existing park are shown in Section 2 of this report.

The 1972 agreement allowed either party to terminate its terms after the expiration of 25 years. To date, neither party has exercised this right, and the Park facilities continue to be operated by the City.

The proposed flood control improvements at Haster Basin will significantly impact many of the Park facilities constructed by the City, removing many trees and most of the picnic tables.



PERIMETER ROAD GRADING CONCEPT

Figure No. 8-3

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

BASIN DRAIN SWALE SECTION

$FILE$ 3/30/2010

Although the agreement specifically states that the County has a right to remove any facility or landscape improvement which interferes with the operation of the Basin as a flood control facility, without compensation; the County, recognizes the importance of maintaining a park at the Haster site, and is committed to restoring recreational use of the site after the completion of the flood control facilities.

The City has stated in an e-mail correspondence that for safety, liability, maintenance, and cost reasons, Garden Grove does not wish to utilize the Basin's interior slopes or the bottom of the Basin for Park purposes. The City will continue to maintain park facilities in the margins between the top of Basin slope and property line only if the County installs a security fence around the entire Basin perimeter. The County would then be responsible for maintaining the Basin's interior slopes and would assume all liability associated with the Basin itself. If the Flood Control District does not install the security fence, then the City would assume no responsibility for the site and terminate the current agreement. This e-mail correspondence is included in Section D of the Technical Appendices for reference.

After exploring several recreational improvement options, re-landscaping the basin perimeter and retaining the lake for water quality purposes was chosen as the best option.

This alternative will possibly re-landscape the margin areas between the top of Basin slope and property line. The lake will be maintained for water quality purposes and aesthetic value. A security fence would be installed around the entire perimeter of the lake to prevent public access.

This alternative is presently favored as it will keep the City of Garden Grove involved with the operation and maintenance of the park facilities; it addresses water quality issues; it has a lower cost to implement; and it restores existing park features to current levels or better. The proposed restoration approach is depicted in Figure 8-4, and described in Table 8-1.

TABLE 8-1
PROPOSED PARK RESTORATION

1)	Hydroseeding of regraded slopes with native vegetation and surface irrigation between the high water level in the Basin and the perimeter maintenance road.
2)	New plantings (trees, shrubs, and groundcover) and irrigation will be located between the Basin perimeter road and the adjacent property line fencing surrounding the project. The new plantings may or may not occur.
3)	Construct a new 15-foot wide pathway (10-foot asphalt concrete pathway for vehicular/bicycle use with an adjacent 5-foot wide decomposed granite pathway for pedestrian use. The new pathway will generally follow the same alignment as the existing perimeter road.
4)	New tubular steel decorative fencing, black in color, located at the top of the basin slope.
5)	Existing playground and restroom would be retained in place.
6)	Existing picnic tables, benches, and trash receptacles which are removed by construction will be replaced.

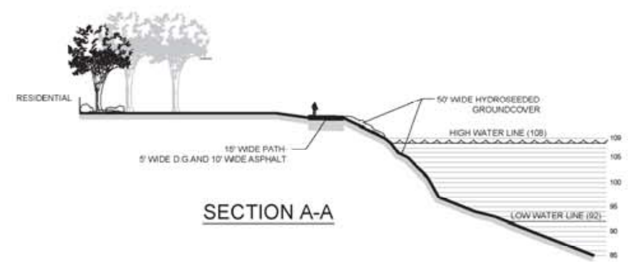
HYDROSEED MIX

NATIVE WILDFLOWER

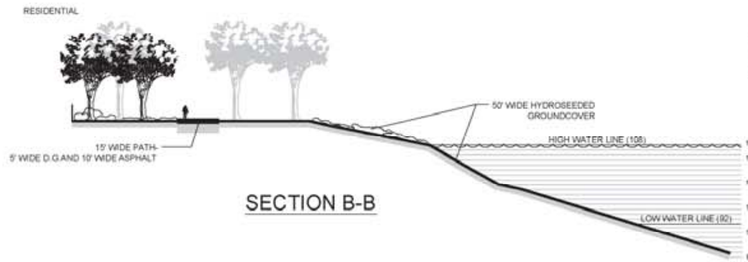
NATIVE WILDFLOWER SPECIES IN MIX

Firecracker penstemon (Penstemon eatonii) 8%
Palmer penstemon (Penstemon palmeri) 7%
Desert marigold (Baileya multiradiata) 3%
Mexican hat (Ratibida columnifera, red) 8%
Yellow prairie coneflower (Ratibida columnifera) 8%
Purple Aster (Aster bigelovii) 4%
Blanketflower (Gaillardia aristata) 8%
Firewheel (Gaillardia pulchella) 8%
Blue flax (Linum lewisii) 8%
Arroyo lupine (Lupinus succulentus) 5%
Arizona lupine (Lupinus arizonica) 2%
Blackfoot daisy (Melampodium leucanthum) 5%
Showey goldeneye (Viguiera multiflora) 8%
Black-eyed Susan (Rudbeckia hirta) 5%
Plains coreopsis (Coreopsis tinctoria) 8%
California poppy (Eschscholzia calif.-naturalized) 5%

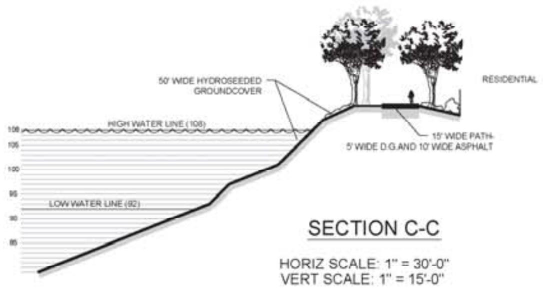
Purity: 98.44%
Germination: 82%
Crop: .02%
Weed: .01%
Inert: 1.53%
Noxious: None found
Tested 9/15/05



SECTION A-A



SECTION B-B



SECTION C-C

HORIZ SCALE: 1" = 30'-0"
VERT SCALE: 1" = 15'-0"

PARK PLAN-ALTERNATIVE A
HASTER BASIN

David Volz Design
Landscape Architects and Park Planners

July, 2007

Figure No. 8-4

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

ALTERNATIVE 4A
CONCEPT PLAN

$FILE$ 3/30/2010

8-7 PUMP STATION SUMP, ACCESS ROAD

A concrete access road will be constructed to the front of the sump structure to allow truck access to the pump station trash rack. The road, as proposed, is graded at an 8% slope. It would be 20 feet wide with a 6-inch curb on each side (see Figures 8-5 and 8-6). At the sump structure, the road elevation will be 92.0 feet, which is also the estimated groundwater level. It is envisioned that this section of road will be continuously under water. Because of the limited storage volume available in the Basin, it is not possible to raise the roadway so that it is normally dry, without compromising the hydraulics of the Basin. When access to this area is needed, it is recommended that the Basin drain pipe be opened, and the Basin pumped down to elevation 91.0 feet.

8-8 FLOOD WALL

It is recommended that a flood wall be constructed around the Basin spillway to provide additional protection for the homes in the area. It is envisioned that this wall would have a top elevation of 114.0 feet. The proposed location of the wall is shown on Figure 8-5. A total of 500-LF of wall is proposed to be constructed.

8-9 BASIN FENCE

PHOTO 8-6. Proposed Basin Fence Design

The City of Garden Grove has requested that a fence be installed at the top of the Basin slope to protect members of the public from falling into the lake. While it will be important to preserve views of the lake for visitors and homeowners bordering the park, safety is an overriding concern.

It is recommended that the fence design be in compliance with the City of Garden Grove Municipal Code for swimming pools. This code requires the minimum height of the fence to be 60 inches, with no more than 2-inch vertical clearance from the ground. The fence is proposed to be an ornamental steel picket type designed with the pickets at the top pointing outward (as shown in Photograph 8-6). The pump station area will be enclosed by a 6 foot high fence of the same type. It will roughly follow the edge of the perimeter road and will feature three 25-foot long motorized gates for vehicle access.

8-10 BASIN DRAIN PIPE

To drain the Basin, a 54-inch pipe will be installed at the Basin low point and routed to the sump. The pipe would be opened or closed via a slide gate installed in the sump. The Basin can be pumped down to elevation 90 feet by use of one of the main pumps. Below elevation 90 feet, the large sump pump (6.7-cfs capacity) would be used to pump out the remaining water. It will require approximately one (1) full day to completely pump down the Basin from elevation 90 feet using the large sump pump. The location of the proposed Basin drain pipe is shown on Figure 8-7.

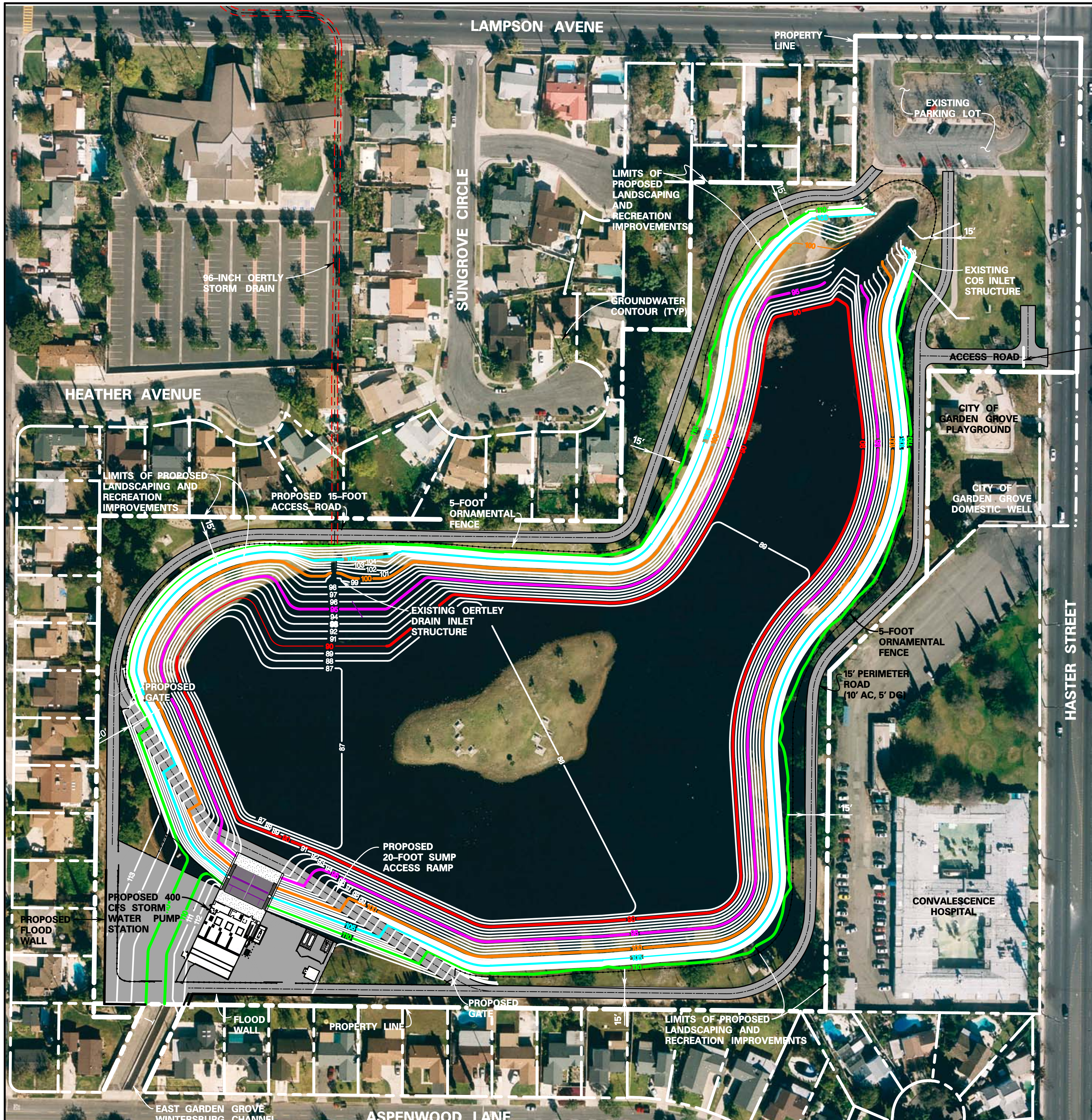

Figure No. 8-5

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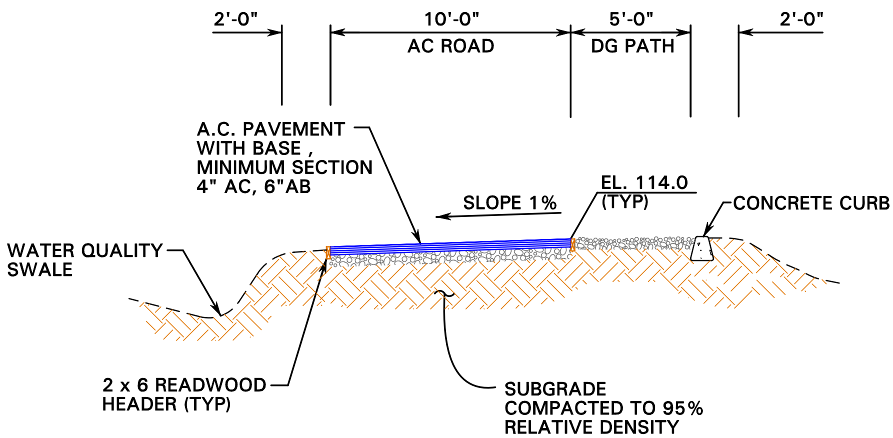
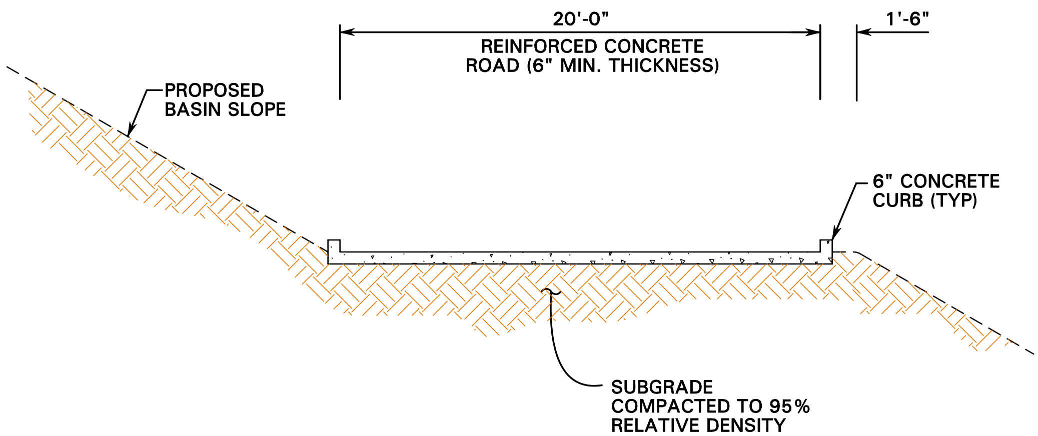
HASTER BASIN/TWIN LAKES PARK PUMP STATION

PROPOSED SITE IMPROVEMENTS

$FILE$ 3/30/2010



PROPOSED PERIMETER ROAD



PROPOSED SUMP ACCESS ROAD

Figure No. 8-6

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HASTER BASIN/TWIN LAKES PARK PUMP STATION

PROPOSED PERIMETER
ROAD AND SUMP ACCESS
ROAD CROSS-SECTIONS

$FILE$ 3/30/2010

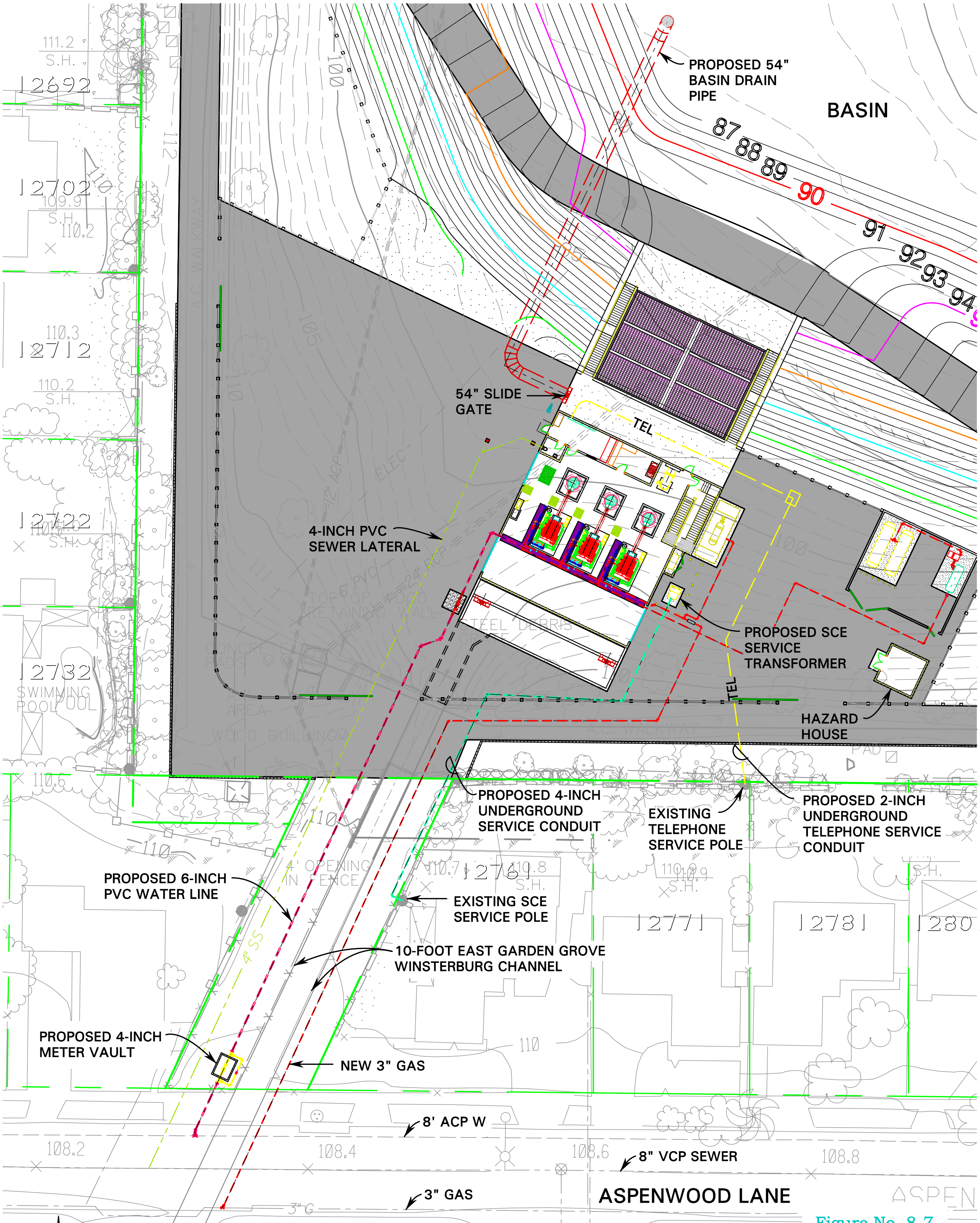

Figure No. 8-7

N

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ORANGE COUNTY PUBLIC FACILITIES & RESOURCES DEPARTMENT

HASTER BASIN/TWIN LAKES PARK PUMP STATION

PROPOSED PUMP STATION
UTILITY SERVICE CONNECTIONS

$FILE$ 3/30/2010

8-11 UTILITY SERVICES

Water, sewer, natural gas, telephone, and electrical services will be required for the pump station project. Figure 8-7 shows the anticipated routing of each service to the pump station site. A brief description of each service is provided below.

8-11.1 Water

Water demand for the project is estimated as follows:

- Heat Exchangers 300-gpm
- Irrigation System 200-gpm
- Right Angle Gear Drive 15-gpm
- Miscellaneous Water 5-gpm

A building fire sprinkler system or fire hydrant is not required for the project. A letter from the City of Garden Grove specifically stating that these systems would not be needed is included in Section D of the Technical Appendices.

Two water services will be secured for the project.

- *A 3-inch meter service* will be obtained near the City's water well to provide irrigation for the project's landscaped areas. Water demand for this meter is estimated at 200-gpm.
- *A 4-inch meter service* will be obtained to supply water to the pump station from a connection to an existing 8-inch pipe in Aspenwood Lane. Water demand for this meter is estimated at 320-gpm. The waterline extending from the meter to the pump station will be 6-inch PVC, AWWA C900 Class 200 pipe. It will be located in the access road adjacent to the outlet channel. The water meter will be installed in a vault and will incorporate a bypass in accordance with City of Garden Grove Standard Drawing B-724.

A reduced pressure principle backflow preventer will be installed downstream of each meter in accordance with City Standard Drawing B-771.

8-11.2 Sewer

A sewer service will be required for the toilet and sink installed at the pump station. A 4-inch sewer lateral will be constructed in the access road adjacent to the outlet channel. A minimum Health Department required separation of 6-feet must be provided from the watermain. The sewer will connect to a City of Garden Grove 8-inch sewer in Aspenwood Lane, in accordance with City of Garden Grove Standard Drawing S-111.

8-11.3 Natural Gas

Natural gas service will be required to supply the engine pump drivers and the emergency generator. The service should be sized to deliver 15,000,000 MBTU/hr of gas to the pump station.

According to the SCG service coordinator, Robert Ozuna, there is a 3-inch medium pressure gas line (60-psi) in Aspenwood Lane which is capable of supplying the project. SCG would be responsible for constructing the line from Aspenwood to the service meter. The County will be responsible for constructing the pipe downstream of the meter to each engine. The size of this line is estimated to be 6 inches.

SCG will charge the County for constructing the service, however this charge will not be quantified until a service plan is prepared by SCG. The SCG service planner has also indicated than an easement may be required for their pipeline. A final determination on the easement requirement will not be made until a service plan is prepared for the project.

8-11.4 Power

Three-phase, 480 volt electrical service will be required for the project. The estimated electrical load is 342-amps. Electrical service size required would be 400-amps.

The SCE service planner, Jeff Gilbert, has indicted that power may be obtained from the pole located adjacent to the Aspenwood entrance access road. One 4-inch conduit would be constructed to a transformer pad located on the pump station site. One 4-inch secondary conduit would then be routed from the transformer to the meter location.

The County will be responsible for constructing the electrical conduits, transformer pad, and the meter socket. SCE will install the wire, transformer and meter head.

8-11.5 Telephone

A standard dial-up telephone service will be obtained for the project. Service is available from a pole located behind the properties at 12771 and 12781 Aspenwood Lane. As requested by the County, 6-pairs of phone lines will be provided. The County will be responsible for installing the conduit. The Telephone Company will install the cable and service equipment.

8-12 PROPERTY ACQUISITION

All facilities proposed for the project are located within the County property line. No property acquisitions will be required.

8-13 COST

The estimated cost to construct the proposed site improvements is $3,167,281. These costs are broken down in Table 8-2. All costs are based on an ENR cost index of 9183.

TABLE 8-2
SITE IMPROVEMENT COST ESTIMATE

Item	Quantity	Unit Cost	Total Cost
Driveway	LS		$5,000
AC Pavement (Road)	37,000 SF	$12	$444,000
AC Pavement (Pump Station)	35,910 SF	$12	$430,920
AC Pavement (Outlet Channel)	4,914 SF	$12	$58,968
Concrete Pavement	12,600 SF	$25	$315,000
5' Decomposed Granite Path	18,500 SF	$2	$37,000
Picket Fence at Top of Basin Slope	4,121	$70	$288,470
Motorized Gates for Pump Station Access	3 EA	10,000	$30,000
Flood Wall	494 LF	$200	$98,800
Irrigation Water Service	LS	$60,000	$60,000
Pump Station Water Service	LS	$90,000	$90,000
Electrical Service	LS	$20,000	$20,000
Telephone Service	LS	$10,000	$10,000
Sewer Service	LS	$30,000	$30,000
Site Restoration	LS	$866,000	$866,000
Total Cost			$2,784,158
15% Contingency			$417,624
TOTAL ESTIMATE			**$3,201,782**

Section 9
CONSTRUCTION ISSUES

9-1 GENERAL

The construction of the project will involve many significant and interrelated issues. The overall success of the project will depend, in many ways, on how the construction issues are handled. This includes public relations, scheduling, construction management, and construction sequencing.

It is recommended that the work be scheduled so that the selected Contractor is ready to begin work immediately after the end of the rainy season (April 15). This will require that bids be received no later than November of the preceding year.

It is expected that pump station construction will begin immediately after the grading and site improvement project phase is complete. The work will be sequenced to finish construction activities in the Basin first (during the dry weather period), and work outside the Basin, during the winter months.

The Haster Basin is anticipated to extend through three (3) rainy seasons, and bypassing of flows to provide the current level of flood protection will be a critical part of the construction program. Shoring and dewatering will also be important considerations in determining how the work can be completed, without damaging the homes adjacent to the construction site.

The following subsections discuss phasing, scheduling, and construction issues related to both grading of the Basin and pump station construction. Also discussed are general construction issues which relate to each phase of the work.

9-2 GRADING, SITE WORK, AND PUMP STATION CONSTRUCTION

9-2.1 General

The grading, site work, and pump station will be packaged as one project. The work included would be as follows:

- Demolition of Existing on-site facilities including the Existing Well
- Grading of the Basin
- Reconstruction of the City of Garden Grove Domestic Water Well, Pump to Waste Line
- Construction of the Perimeter Road and New Access Road from Haster Street
- Installation of Irrigation and Landscaping Systems, including Site Improvements
- Construct Pump Station

9-2.2 Public Use of the Park during Construction

Public use of the park site can be accommodated during construction of the pump station. The parking lot, children's play area, and much of the walking trail can remain open. The Contractor will be required to install security fencing around the areas of work to protect the public from unsafe areas at the onset of the project. Requirements stipulating limits on the Contractor's work area and public use of the park during construction will be fully defined in the bid documents for the project.

9-2.3 Construction Phasing

A goal of the project will be to allow use of the park during much of the construction operation. To achieve this goal, the following construction sequencing has been developed.

1) Dewater Basin to existing groundwater level (the existing pump station may be used for this purpose).

2) Install diversion system to maintain dry weather flows collected by the East Garden Grove-Wintersburg Channel.

3) Construct driveway and access Road from Haster Street – Children's play area would be closed during this work.

4) Install diversion system to handle dry weather flows from the Oertley Storm Drain

5) Completely Dewater the Basin – Provide temporary piping system to discharge flow to the downstream channel.

6) Remove Trees and Facilities around the Basin – Clear, grub, and grade the basin. The entire basin should be closed for safety purposes until it can be re-landscaped, a road constructed, and the perimeter fence installed. Parking lot must remain closed as trucks will be continuously accessing the site from this area.

7) Re-open Parking Lot – After completion of the site grading, large trucks will no longer be passing through the parking lot. The public will be allowed to use it, but the children's play area should remain closed.

8) Reconstruct City of Garden Grove Well Facility Discharge Pipe – It is recommended that the entire park within the County property remain closed. The park parking lot should be reopened, but the Children's play area should remain closed.

9) Installation of Irrigation Systems – A connection to the City's domestic water system near the water well will be required. The entire park within County property should remain closed. The parking lot may remain open but the children's play area should be closed.

10) Construct Perimeter Road – The road encircling the Basin should be completed after installation of the irrigation system. Access to County-owned areas of the park should not be allowed while road construction is proceeding.

11) Restore Park Landscaping; Construct Recreational Improvements – The Park could be reopened at this point, however use would be limited to the children's play area and newly constructed perimeter road.

12) Construct Pump Station – The parking lot, children's play area, and most of the trail can remain open for this portion of work

9-2.4 Contractor Access to the Site

All construction traffic is to be routed through the Haster Street entrance which is recommended to be constructed under the grading phase of the project.

The City will not allow construction vehicles to access Haster Basin via the Aspenwood entrance. Access from the parking lot should not normally be allowed as it will be in use by the public. Prohibiting access from the parking lot will protect park visitors from potential injury from construction equipment/construction activities. Eliminating this location as a point-of-access will also protect roadway and landscape improvements installed under the initial phase of work from construction damage.

9-2.5 Pump Station Excavation

One of the more challenging aspects of the pump station construction will be the excavation for the sump. Shoring, high groundwater conditions, and inflow of surface water must all be addressed before construction can proceed.

It is anticipated that to shore and protect the excavation from groundwater intrusion, sheet piling will be used. As envisioned, sheet piles would be driven on all four sides of the proposed excavation into a clay lens located 45-feet beneath the site (approximate elevation 69-ft). The sheet piling would create a cofferdam, inside from which, excavation for the sump could proceed. Driving the piles into the clay layer would effectively cut off the surrounding groundwater from entering the excavation area. Dewatering could then be conducted from inside the shoring system and would be limited to water already trapped within the sheet piled area plus any water that may seep through seams in the sheet piling or from the bottom through the clay lens. The Hydrogeologic Study estimated dewatering rates inside the shoring system would be low.

The top of the piles would be extended to a minimum height of elevation 111-feet. This will prevent drainage flowing into the Basin, from entering the excavation. To allow the Basin to function normally during a storm event, a temporary 10-foot wide channel lined with gunnite would be constructed adjacent to the shored excavation, and connected to the existing 10-foot by 5.5-foot outlet RCB.

Excavation inside the cofferdam would proceed from the surface until the reach of the excavating equipment is exceeded. At that time, small equipment (such as a bobcat) would be lowered into the excavation area to complete the digging. As the excavation proceeds downward, internal bracing would be installed as required by the shoring plan to support the shoring system.

Once the sump structure is constructed, the area between the sheet piling should be backfilled and compacted to the surface. Sheet piling should be removed after backfilling is complete. If pile removal is difficult or if it generates excessive vibration, then sheeting may be cut off 8 feet below the surface and left in place.

9-2.6 Dewatering Operations

Grading of the Basin and construction of the inlet storm drain improvements will require dewatering of the Basin. Initial dewatering should be performed by using the existing pump station located near the Basin outlet which incorporates two 2,500-gpm (5.6-cfs) pumps. Using both pumps, it will require approximately 5 days to drain the Basin from elevation 100-feet (the normal water surface elevation) to elevation 92-feet (estimated groundwater level).

As the quality of the water contained in the Basin is generally poor (high bacteria levels), it may also be necessary to treat the pumped water prior to discharging it to the downstream channel. Final determination of the treatment system to be used, if any, should be identified by the project WQMP. All treatment requirements specified by the WQMP will be fully defined in the final construction documents prepared for the project.

In order to complete the grading of the Basin, all water will need to be completely pumped out (surface water and subsurface water). The pumping capacity required to accomplish Basin dewatering below the existing groundwater level is currently unknown and will require test pumping of a monitoring well installed by Ninyo and Moore during the Hydrogeologic Report to quantify (see Section 4). This work was included as an optional item in the Hydrogeologic Study proposal, but was not authorized by the County. It is essential that this investigation be completed so that dewatering conditions may be fully disclosed in the bid documents for the project. As currently envisioned, a trench would be constructed in the bottom of the Basin to collect the groundwater and pumped out using sump pumps.

9-2.7 Settlement Monitoring Program

Monitoring of several site and geologic conditions is recommended throughout the duration of the construction of the pump station. Specifically, settlement of the ground surface in the areas adjacent to the construction activities should be consistently monitored and documented. The installation and removal of shoring, failure of shoring, and subsidence of the ground surface due to excess dewatering can all cause ground settlement.

Shoring will be required for the construction of the pump station sump. When shoring is driven into the ground, the earth beneath the piles is driven and displaced. This may result in ground settlement adjacent to the construction of the pump station. Ground settlement can detrimentally damage adjacent facilities including, but not limited to, utilities, pools, sidewalks, and structures. Additionally, if shoring is not constructed properly, or if over-excavation is allowed to occur (and the shoring fails), a catastrophic cave-in or collapse of the excavation can take place causing settlement. Shoring must be constructed in accordance with a design prepared by a qualified Registered Civil or Structural Professional Engineer licensed by the State of California.

The following sections discuss monitoring procedures which should be implemented during the construction of the pump station.

9-2.7.1 Construction Vibrations

Piles which are driven into the ground can transmit some of the driving energy into the adjacent soil that can be experienced on the surface as vibration. Vibrations cannot only cause discomfort to occupants of nearby homes, but also cause settlements of the sandy soil underlying structures resulting in damage. The Geotechnical Report recommended maintaining vibrations below a peak particle velocity of 0.2-inch per second to limit settlement to an acceptable level.

Restrictions on the size and type of hammer which may be used to drive piles will be addressed by the project's bid specifications. If possible, a sheet piling press should be used for driving piles. A Press produces the least noise and vibration; however, it may not be suitable for the soils which are present at the site. Impact hammers create the most noise and vibration and should not be allowed on the project. Vibration hammers should be limited to the minimum size required to install the piles.

It is recommended that a minimum of two (2) seismographs be installed prior to sheet pile driving operations at the property lines of the homes located directly to the south and west of the proposed excavation. It is also recommended that a third seismograph be located further away from the excavation to the east, to monitor vibrations as a function of distance.

The seismographs should be continuously monitored during pile driving and removal operations. Peak particle velocities observed in excess of the 0.2-inch per second would cause driving operations to be discontinued until a mitigation procedure to reduce the vibration to an acceptable level can be developed.

9-2.7.2 Groundwater Monitoring

Settlement of the ground surface may also result from the drawdown of the water table during dewatering. Although dewatering inside the shoring system should limit drawdown of the surrounding groundwater level, it is still recommended that monitoring wells be installed along the south and east sides of the proposed excavation. The groundwater level should not be lowered more than 3 feet below the bottom of the proposed excavation.

Groundwater levels observed below the 3-foot limitation will be immediate cause for all dewatering activities to be shutdown. Dewatering of the site should not be allowed to resume until a mitigation plan is developed by the Contractor and agreed to by the County.

Groundwater levels should be monitored once per day, or more frequently, depending upon the dewatering system installed by the Contractor.

9-2.7.3 Lateral Movement

It is recommended that one inclinometer be installed on the south side of the pump station excavation to provide advanced warning of soil instability. Inclinometer wells should be monitored on a daily basis during excavation. Movement observed in excess of ½-inch per day total, will be cause for the pump station excavation to be discontinued until remediation measures can be proposed by the Contractor and agreed to by the County.

9-2.7.4 Settlement Monitoring Points

Ground surface settlement points are recommended to be installed around the south and west sides of the proposed excavation at 20-foot spacing.

Settlement monitoring points should be surveyed daily by a licensed surveyor or engineer. Settlement observed in excess of ½-inch shall cause construction operations to be discontinued until a remediation plan can be prepared by the Contractor and agreed to by the County.

Survey points are also recommended on all homes located within 100 feet of the site (if allowed by the property owner). These points should also be surveyed on a daily basis to provide a record of the structure performance during construction, and may be helpful in defending against potential damage claims.

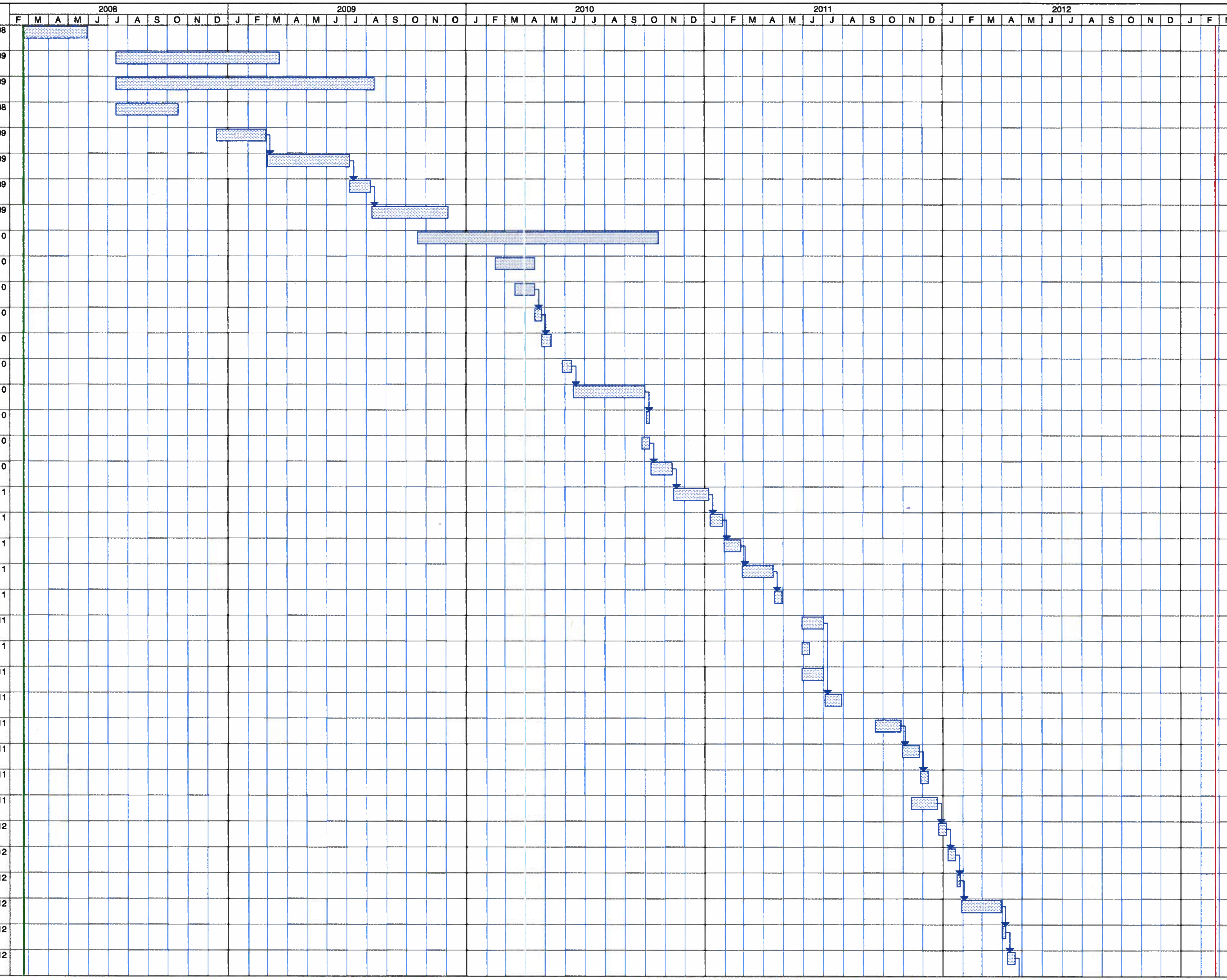
9-2.8 Schedule

The projected schedule for completing the entire project is shown on Figure 9-1. The schedule is predicated upon no work beginning at the site until the end of the rainy season (April 15). As shown by the schedule, all grading operations will be completed by October 1, and would be not subject to damage from stormwater entering the Basin. Grading operations will occur on both the north and south side of the basin concurrently. This will, however, completely eliminate any use of the park during this phase of work.

The schedule has been developed to allow the selected Contractor to begin work on the pump station immediately after the grading and site improvements are completed (April 2011). Completion of the project is anticipated to be February 22, 2013. The total construction period from Notice-of-Award to project completion is 1,326 calendar days (3½ years) for the project.

PROJECT SCHEDULE
Haster Basin Project
September 2008

ID	Task Name	Duration	Start	Finish
1	Preliminary Design Report Approval	71 days	Fri 2/22/08	Fri 5/30/08
2	Environmental Documentation	180 days	Mon 7/14/08	Fri 3/20/09
3	Plan and Specification Preparation	284 days	Mon 7/14/08	Thu 8/13/09
4	Resource Agency Permits	70 days	Mon 7/14/08	Fri 10/17/08
5	Bid Period	55 days	Mon 12/15/08	Fri 2/27/09
6	Project Award	91 days	Mon 3/2/09	Mon 7/6/09
7	Contract and Insurance Documents	24 days	Tue 7/7/09	Fri 8/7/09
8	Shop Drawing Reviews	85 days	Mon 8/10/09	Fri 12/4/09
9	Equipment Procurement (long lead time items)	265 days	Mon 10/19/09	Fri 10/22/10
10	Mobilization	44 days	Mon 2/15/10	Thu 4/15/10
11	Initial Basin Dewatering	22 days	Wed 3/17/10	Thu 4/15/10
12	Install C05 and Oertley Diversion System	7 days	Fri 4/16/10	Mon 4/26/10
13	Construct Access Road from Haster Street	10 days	Tue 4/27/10	Mon 5/10/10
14	Complete Basin Dewatering	11 days	Fri 5/28/10	Fri 6/11/10
15	Clear, Grub and Grade Basin	80 days	Mon 6/14/10	Fri 10/1/10
16	Reconstruct City of Garden Grove Well Outlet	5 days	Mon 10/4/10	Fri 10/8/10
17	Construct City of Garden Grove Irrigation Service Connection	10 days	Mon 9/27/10	Fri 10/8/10
18	Install Site Irrigation System	25 days	Mon 10/11/10	Fri 11/12/10
19	Construct Basin Perimeter Road	40 days	Mon 11/15/10	Fri 1/7/11
20	Restore Park Landscaping, Construct Recreational Improvements, Install Perimeter Fence	15 days	Mon 1/10/11	Fri 1/28/11
21	Demolish Existing City of Garden Grove Water Well and Monitoring Wells	20 days	Mon 1/31/11	Fri 2/25/11
22	Install Groundwater Monitoring Wells and Settlement Monitors (conduct pre-construction video survey)	35 days	Mon 2/28/11	Fri 4/15/11
23	Demolish Exist'g City of Garden Grove PS, Outlet Channel Headwall, Misc. Piping Sys., Exist'g Paving	10 days	Mon 4/18/11	Fri 4/29/11
24	Install Sheet Piling	25 days	Mon 5/30/11	Fri 7/1/11
25	Install Diversion Channel	10 days	Mon 5/30/11	Fri 6/10/11
26	Excavation Inside Coffer Dam. Install Bracing on Sheet Piling	25 days	Mon 5/30/11	Fri 7/1/11
27	Construct Sump Foundation	20 days	Mon 7/4/11	Fri 7/29/11
28	Construct Sump Walls and Stairs	30 days	Mon 9/19/11	Fri 10/28/11
29	Construct Seal Weir Structure (do not construct interior wall or deck)	20 days	Mon 10/31/11	Fri 11/25/11
30	Install 54-Inch Discharge Pipes and 36-Inch Drain Pipe	10 days	Mon 11/28/11	Fri 12/9/11
31	Rough-In Below Grade Conduits	30 days	Mon 11/14/11	Fri 12/23/11
32	Construct Building Footing	10 days	Mon 12/26/11	Fri 1/6/12
33	Construct Engine Bases	10 days	Mon 1/9/12	Fri 1/20/12
34	Construct Building Floor Slab	5 days	Mon 1/23/12	Fri 1/27/12
35	Construct Block Building	45 days	Mon 1/30/12	Fri 3/30/12
36	Install Pumps	5 days	Mon 4/2/12	Fri 4/6/12
37	Install Engines	10 days	Mon 4/9/12	Fri 4/20/12

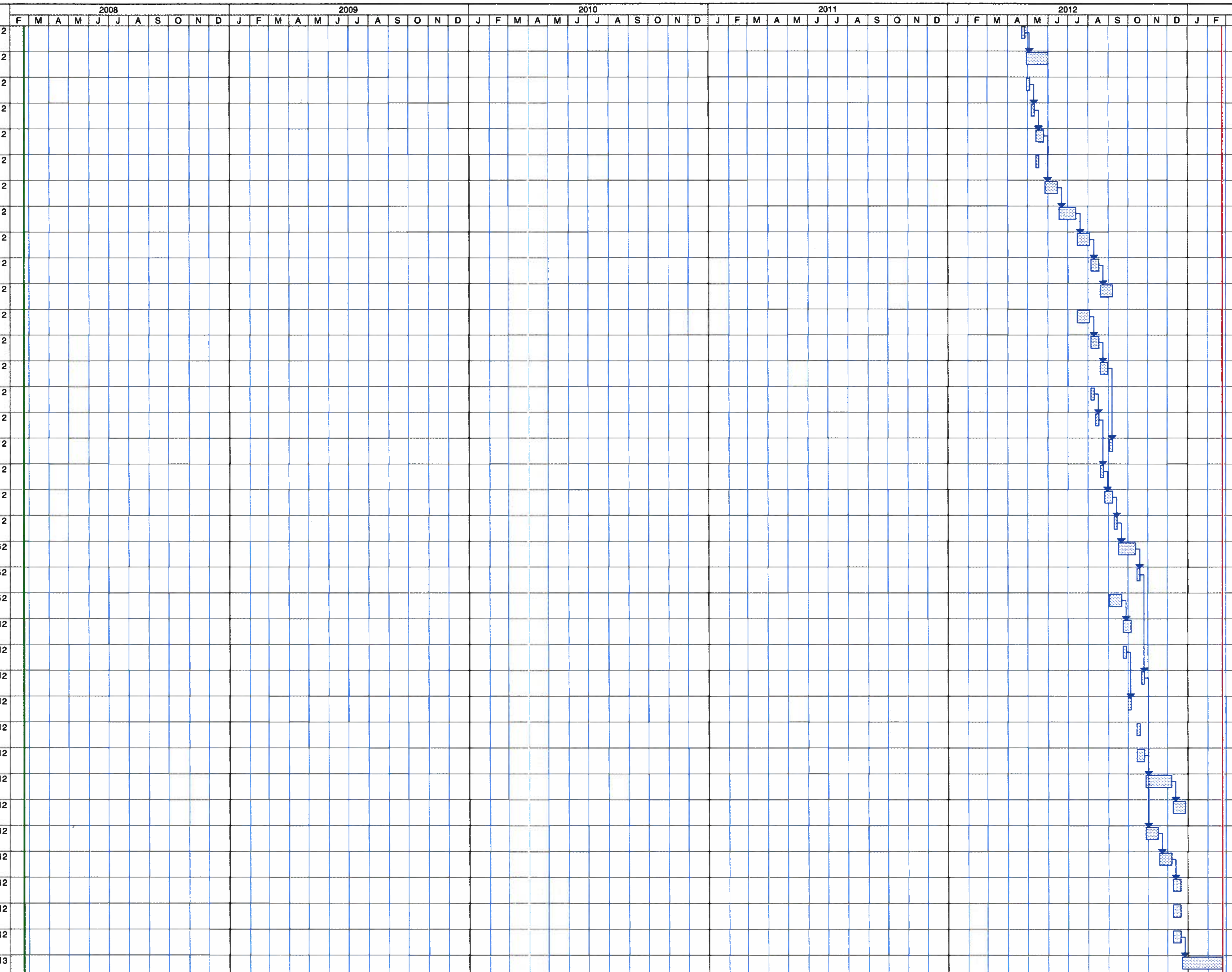


Task   Split   Progress   Milestone   Summary

FIGURE 9-1

PROJECT SCHEDULE
Haster Basin Project
September 2008

ID	Task Name	Duration	Start	Finish
38	Install Stairs to Roof	5 days	Mon 4/23/12	Fri 4/27/12
39	Install Roof System	25 days	Mon 4/30/12	Fri 6/1/12
40	Install Sump Stairs	5 days	Mon 4/30/12	Fri 5/4/12
41	Install Sump Pumps	5 days	Mon 5/7/12	Fri 5/11/12
42	Install Heat Exchanges and Misc. Sump Piping	10 days	Mon 5/14/12	Fri 5/25/12
43	Install Ductwork in Sump	5 days	Mon 5/14/12	Fri 5/18/12
44	Install Trash Rack	15 days	Mon 5/28/12	Fri 6/15/12
45	Pull Sheet Piling	20 days	Mon 6/18/12	Fri 7/13/12
46	Backfill Around Structure	15 days	Mon 7/16/12	Fri 8/3/12
47	Dewater Basin to Elevation 90-Ft.	10 days	Mon 8/6/12	Fri 8/17/12
48	Construct Concrete Road to Pump Station Trash Rack	15 days	Mon 8/20/12	Fri 9/7/12
49	Construct Outlet RCB Connect to Existing Outlet Storm Drain	15 days	Mon 7/16/12	Fri 8/3/12
50	Install 4-Inch Water Service from City of Garden Grove	10 days	Mon 8/6/12	Fri 8/17/12
51	Install 4-inch Sewer Service from City of Garden Grove	10 days	Mon 8/20/12	Fri 8/31/12
52	Install Electrical Service Transformer Slab Box	5 days	Mon 8/6/12	Fri 8/10/12
53	Install SCE Service Conduits	5 days	Mon 8/13/12	Fri 8/17/12
54	Install SCG Gas Service (by SCG)	5 days	Mon 9/3/12	Fri 9/7/12
55	Install Telephone Service Conduits	5 days	Mon 8/20/12	Fri 8/24/12
56	Install Yard Conduits Set Outdoor Meter Service	10 days	Mon 8/27/12	Fri 9/7/12
57	Set Indoor MCL - Install Murphy Control Panels	5 days	Mon 9/10/12	Fri 9/14/12
58	Install Building Conduit Pull Wire	20 days	Mon 9/17/12	Fri 10/12/12
59	Install Building Lights	5 days	Mon 10/15/12	Fri 10/19/12
60	Install Misc. Piping in Pump Room Bathroom	15 days	Mon 9/3/12	Fri 9/21/12
61	Install Sump Supply Fan and Roof Exhaust Fans	10 days	Mon 9/24/12	Fri 10/5/12
62	Install Generator	5 days	Mon 9/24/12	Fri 9/28/12
63	Energize Edison Service	5 days	Mon 10/22/12	Fri 10/26/12
64	Install LPG Tanks, Vaporizor and Piping	5 days	Mon 10/1/12	Fri 10/5/12
65	Construct 6-foot Wall at Property Line	5 days	Mon 10/15/12	Fri 10/19/12
66	Construct Flood Walls	10 days	Mon 10/15/12	Fri 10/26/12
67	Start-Up Testing	30 days	Mon 10/29/12	Fri 12/7/12
68	Construct Seal Weir Wall and Top Deck	15 days	Mon 12/10/12	Fri 12/28/12
69	Installation of Irrigation System Piping	15 days	Mon 10/29/12	Fri 11/16/12
70	Yard Paving and Perimeter Fence	15 days	Mon 11/19/12	Fri 12/7/12
71	Building Stucco Finish	10 days	Mon 12/10/12	Fri 12/21/12
72	Operator Training	10 days	Mon 12/10/12	Fri 12/21/12
73	Landscaping	10 days	Mon 12/10/12	Fri 12/21/12
74	Punch List	45 days	Mon 12/24/12	Fri 2/22/13



Task | Split | Progress | Milestone | Summary

FIGURE 9-1

9-3 GENERAL CONSTRUCTION REQUIREMENTS

9-3.1 Public Relations

The project will be visible to the community and will affect the local area. Therefore a community relations program developed and conducted by the County will be an important component in achieving a successful project.

Information can be distributed before work begins which describes each project, why it is necessary, provide estimated construction durations, and describe the impacts and benefits to the community. Keeping the community involved reduces the level of frustration during the construction period, and allows the work to progress smoothly. At a minimum, this information should be distributed to the surrounding businesses and homes in the immediate vicinity of the jobsite. Meetings conducted prior to starting work, and at 3-month intervals during construction, should also be considered to receive public input and to address public concerns.

9-3.2 Noise

The work will occur in a residential community where noise will be a significant issue. Construction activities such as those proposed for Haster Basin are exempt from the City's noise ordinance. However, some noise mitigating measures can and should be included in the contract documents to minimize the impact to the homes in the immediate vicinity of the work. These will include:

- Providing sound attenuated enclosures for generators, compressors, and pumping equipment.
- Restrict the use of air-powered tools at the site.
- Require critical grade silencers for all internal combustion engines
- Prohibit work outside the hours of 7:00 a.m. to 5:00 p.m.; and on Saturday, Sunday or holidays
- Prohibit early gathering at the site. No equipment is to be started prior to the approved working hours.
- Require all equipment and vehicles, when not in use, to be turned off (unattended vehicles are not to be left idling).
- Continued dewatering will be required to construct the projects (24 hours/day, 7 days/week). Pumps for dewatering operations will be required to have electric motors. Engine driven pumps will not be allowed. A temporary electric service will be required to power the pumps. The use of portable generators to produce power to operate the pumps will not be allowed.

Any additional noise restrictions which are identified in the project's environmental document will also be included in the contract documents for the project.

As part of the design phase scope of work, a noise study is to be prepared which will estimate noise levels from construction activities and pump station operation, and will provide guidance for minimizing its impact. While originally intended to be a part of the Preliminary Design Report, the study could not be completed until the project scope and equipment to be used were more fully defined. Once the Preliminary Design Report is approved by the County, AKM will proceed with the preparation of the noise study through our subconsultant, Weiland Acoustics.

9-3.3 Preconstruction Survey

It is recommended that a preconstruction survey be conducted at each home located around the perimeter of the site. The preconstruction survey would consist of photographic documentation of the interior and exterior portions of the buildings. Cracks and/or separations which may be present should be noted. Interviews should be conducted and documented with the property owners to obtain information concerning the age and maintenance history of the building prior to construction. The preconstruction survey is contingent upon property owners approving access to their home, and some may decline to participate. However preparing the survey can be beneficial to both parties, as it can refute or substantiate a potential damage claim.

9-3.4 Permits

The following permits will be required for the construction of the project:

- Encroachment Permit – An encroachment permit issued by the City of Garden Grove will be required for the construction of the utility connectors in Aspenwood Lane, destruction of the water well located near the outlet of the Basin, and the destruction of the four (4) monitoring wells that were constructed in Falling Leaf Circle and Oertly Drive during the Hydrogeologic Study. This permit must be obtained by the Contractor. A traffic control plan and insurance documents will be required before the permit will be issued.

- Business License – The Contractor and all of its subcontractors will be required to obtain a business license from the City of Garden Grove.

- Tree Cutting Permit – The City of Garden Grove tree ordinance requires a permit be obtained from the Director of Recreation and Parks, before cutting down a tree in a public area. This permit should be secured by the Contractor but coordinated with the City during the design phase of the project.

- Grading / Building Permit – The County of Orange is exempt from obtaining a grading or building permit for the project. The City has also stated that they will not review the project plans for code compliance and will not issue a permit for the work.

- Air Quality Permit – The Contractor will be required to obtain, in the County's name, a permit to construct, and a permit to operate for the installation of the natural gas engines proposed for the project. All source testing associated with obtaining the permit will be a specified requirement of the contract documents for the Contractor to provide. All fees assessed by SCAQMD related to the permits should be paid by the County.

- Resource Agency Permits – A U.S. Army Corps of Engineers 404 permit, California Department of Fish and Game Section 16000 Permit, and a California Regional Water Quality Control Board's 401 Permit will be required for the project. These permits will be obtained by the County prior to construction. The Contractor will be required to comply with all provisions of these permits.

- Storm Water Pollution Prevention Plan – The Contractor will be required to prepare and submit for approval a Storm Water Pollution Prevention Plan, in compliance with the County's Drainage Area Management Plan, and the project specific water Quality Management plan to be prepared by the County.

- NPDES Permit – The Contractor will be required to comply with the requirements of Order No. R8-2003-06 relating to the discharge of construction dewatering.

SECTION 10

CONSTRUCTION COST ESTIMATES

10-1 CONSTRUCTION COST ESTIMATES

Preliminary construction cost estimates were developed for Haster Basin; and are included herein as Table 10-1. The estimated construction costs do not include planning, engineering, and design (PED) costs. Estimated construction costs are based on the implementation of a Propeller Pump Station, as described in Section 7. The construction cost estimate for Haster Basin is $22,342,000 in 2008 dollars. Inflated to 2011 dollars, the project cost estimate is $25,917,000.

The unit construction cost estimates are based on ENR Index 9183 for Los Angeles (February 2008), and includes 15% for construction contingency. These construction cost estimates are escalated to the mid-point of construction based on the project schedule, and include allowance to cover cost increases due to inflation.

TABLE 10-1
HASTER BASIN
ESTIMATED CONSTRUCTION COSTS

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST		DATE:		6/27/2008	
PROJECT: HASTER BASIN		PREPARED BY:		J. QUINTANA	
		CHECKED BY		J. LOAGUE	
ITEM	**DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
1	**Basin Grading Costs**				
	Clearing and Grubbing	20	AC	$10,000	$200,000
	Earthwork	125,000	CY	$30	$3,750,000
	Hauling	75,000	CY	$20	$1,500,000
	Dewatering	1	LS	$1,000,000	$1,000,000
	Subtotal Item 1				**$6,450,000**
				Total Costs =	**$6,450,000**
				Contingency (15 %) =	**$967,500**
				Total Costs =	**$7,417,500**
				Site Grading, Total Costs	**$7,417,500**
2	**Top of Slope to Property Line**				
	Landscape	92,840	SF	$1.50	$139,260
	Irrigation	92,840	SF	$2.30	$213,532
	Subtotal Item 2				**$352,792**
3	**Basin Slope- Top of Slope to Low Waterline**				
	Landscape	285,265	SF	$0.65	$185,422
	Irrigation	285,265	SF	$1.15	$328,055
	Subtotal Item 3				**$513,477**
				Total Costs =	**$866,269**
				Contingency (15 %) =	**$129,940**
				Total Costs =	**$996,209**
				Site Restitution, Total Costs	**$996,209**

TABLE 10-1
HASTER BASIN
ESTIMATED CONSTRUCTION COSTS *(Continued)*

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
4	**Earthwork**				
	Sheet Piling	27,636	SF	$30	$829,080
	Dewatering	1	LS	$100,000	$100,000
	Excavation Pump/Building	8,482	CY	$75	$636,150
	Excavation for Forebay	2,916	CY	$75	$218,700
	Excavation for Discharge Pipes	2,100	CY	$75	$157,500
	Excavation for Seal Weir Structure	225	CY	$75	$16,875
	Base Gravel	895	CY	$100	$89,500
	Backfill around Pump Structure	600	CY	$100	$60,000
	Backfill for Forebay	375	CY	$100	$37,500
	Backfill around Discharge Pipes	275	CY	$100	$27,500
	Backfill around Seal Weir Structure	175	CY	$100	$17,500
	Subtotal Item 4				**$2,190,305**
5	**Concrete**				
	Concrete Flatwork on Grade	892	CY	$700	$624,400
	Concrete Flatwork above Grade	230	CY	$1,200	$276,000
	Concrete Walls (Formed)	755	CY	$1,000	$755,000
	Subtotal Item 5				**$1,655,400**
6	**Building Cost**				
	Exterior Building Walls (8-inch Block)	8,640	SF	$25	$216,000
	Interior Partitions (including doors)	115	LF	$300	$34,500
	Restroom Facilities	1	LS	$2,000	$2,000
	Office Heat Pump (9,000 BTU unit)	1	LS	$2,500	$2,500
	Exterior Roll-up Doors	3	EA	$10,000	$30,000
	Exterior Entrance/Exit Door	3	EA	$2,000	$6,000
	Building Ventilation (60,000-cfm)	1	LS	$50,000	$50,000
	Building Exhaust Louvers (100-SF)	1	LS	$25,000	$25,000
	Roof System and Roofing	6,100	SF	$50	$305,000
	Building Electrical	1	LS	$100,000	$100,000
	Subtotal Item 6				**$771,000**

TABLE 10-1
HASTER BASIN
ESTIMATED CONSTRUCTION COSTS *(Continued)*

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
7	**Drainage and Pumping Cost**				
	Lake Drainage Piping	150	LF	$500	$75,000
	54-inch Flap Gate	3	EA	$32,000	$96,000
	18-inch Flap Gate	1	EA	$5,000	$5,000
	5' x 5' Slide Gate	2	EA	$65,000	$130,000
	24-inch Gate Valve	1	EA	$15,000	$15,000
	Concrete Slab at Lake Inlet	4	CY	$1,000	$4,000
	Sump Pump (3,125 GPM @ 17 TDH)	1	EA	$70,000	$70,000
	Sump Pump Piping	40	LF	$400	$16,000
	Sump Pump Check Valve	1	EA	$1,000	$1,000
	Sump Pump Gate Valve	1	EA	$1,000	$1,000
	Sump Pump Electrical	1	LS	$7,500	$7,500
	Sump Pump (500 GPM @ 30 TDH)	1	EA	$25,000	$25,000
	Sump Pump Piping	40	LF	$100	$4,000
	Sump Pump Check Valve	1	EA	$500	$500
	Sump Pump Gate Valve	1	EA	$500	$500
	Sump Pump Electrical	1	LS	$2,500	$2,500
	Subtotal Item 7				**$453,000**
8	**Storm Water Pumps & Misc.**				
	Centrifugal Pumps	3	EA	$630,000	$1,890,000
	Engine Drive for Pump	3	EA	$581,000	$1,743,000
	Right Angle Drive and Drive Shaft	3	EA	$80,000	$240,000
	Standby Generator (350 kW)	1	EA	$315,000	$315,000
	Bridge Crane	1	EA	$100,000	$100,000
	Electrical	1	LS	$800,000	$800,000
	50' Communications Pole	1	EA	$5,000	$5,000
	Ladder to seal weir structure	2	EA	$1,000	$2,000
	Hazard House - Exterior Building Walls	600	SF	$25	$15,000
	Hazard House - Exterior Entrance/Exit Door	1	EA	$2,000	$2,000
	Hazard House - Roof System and Roofing	225	SF	$50	$11,250
	Subtotal Item 8				**$5,123,250**
				Total Costs =	**$10,192,955**
				Contingency (15 %) =	**$1,528,943**
				Total Costs =	**$11,721,898**
				Pump Station Construction, Total Costs	**$11,721,898**

TABLE 10-1
HASTER BASIN
ESTIMATED CONSTRUCTION COSTS *(Continued)*

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
9	**Site Improvements**				
	Driveway	1	LS	$5,000	$5,000
	AC Pavement (Road)	37,000	SF	$12	$444,000
	AC Pavement (Pump Station)	35,910	SF	$12	$430,920
	AC Pavement (Outlet Channel)	4,914	SF	$12	$58,968
	Concrete Pavement	12,600	SF	$25	$315,000
	5' Decomposed Granite Path	18,500	SF	$2	$37,000
	Picket Fence at Top of Basin Slope	4,121	LF	$70	$288,470
	Motorized Gates for Pump Station Access	3	EA	$10,000	$30,000
	Flood Wall	494	LF	$200	$98,800
	Irrigation Water Service	1	LS	$60,000	$60,000
	Pump Station Water Service	1	LS	$90,000	$90,000
	Electrical Service	1	LS	$20,000	$20,000
	Telephone Service	1	LS	$10,000	$10,000
	Sewer Service	1	LS	$30,000	$30,000
	Subtotal Item 9				**$1,918,158**
				Total Costs =	**$1,918,158**
				Contingency (15 %) =	**$287,724**
				Total Costs =	**$2,205,882**
				Site Improvements - Total Costs	**$2,205,882**
	SUMMARY OF ESTIMATED CONSTRUCTION COSTS				
				Site Grading =	**$7,417,500**
				Site Restitution =	**$996,209**
				Pump Station Construction =	**$11,721,898**
				Site Improvements =	**$2,205,882**
				Grand Total (2008 DOLLARS) =	**$22,341,489**
				Inflation (16%) =	**$3,574,638**
				Grand Total (2011 DOLLARS) =	**$25,916,127**
				Estimated Construction Costs, Grand Total (2011 DOLLARS)	**$25,916,127**